

Form 9 Update 2  
June 6, 2003

The following changes shall be incorporated into the present Form 9 dated November 15, 1999 and updated December 1, 2000. Appendices which exist shall be replaced by the updated appendices included, appendices that are new shall be added:

1. **Appendix I, Sample Alternate Proposal Sheet**, replace the current form with the updated form.
2. **Appendix J, Sample Addendum Sheet**, replace the current form with the updated form.
3. **Appendix N, Sustainable Design Guidelines**, replace the current appendix with the updated appendix.
4. **Appendix T, CAMIS Building and Equipment Form**, add new appendix.

## APPENDIX I

### SAMPLE ALTERNATE PROPOSAL SHEET

MASSACHUSETTS STATE PROJECT NO.

CONTRACT NO.

(project title)  
(institution)  
(location)

ALTERNATE NO. (1)

If Alternate No. (1),  
as described in paragraph \_\_\_\_\_ of Section \_\_\_\_\_ is accepted by the Commonwealth, the  
proposed contract price shall be revised as follows:

ITEM 1. Work of the General Contractor:  
(being all work other than that covered by Item 2) ADD \$ \_\_\_\_\_

ITEM 2. Sub-Bids:

Section	Sub-Division	**Name of Sub-Bidder	ADD	*Bond Required YES or NO
(sect. number) (File Sub-bid category)	_____	_____	\$ _____	_____
(sect. number) (File Sub-bid category)	_____	_____	\$ _____	_____

**TOTAL ALTERNATE PRICE:**

Sum of items 1 and 2, above  
(Enter on Page 2 of the General Bid Form)  
as Alternate No. (1) price

ADD \$ \_\_\_\_\_

SUBTRACT \$ \_\_\_\_\_

\*Failure to fill in any or all spaces in this column will be construed as entry of the word "NO."

\*\*The General Contractor shall use the same Sub-Bidders for all alternates that were selected for the base bid.

## APPENDIX J

### SAMPLE ADDENDUM SHEET

THE COMMONWEALTH OF MASSACHUSETTS  
EXECUTIVE OFFICE FOR ADMINISTRATION AND FINANCE  
DIVISION OF CAPITAL ASSET MANAGEMENT  
OFFICE OF \_\_\_\_\_

Massachusetts State Project      Contract No.

(project title)  
(institution)  
(location)

ADDENDUM NO. 1  
(date)

The attention of bidders submitting proposals for the subject project at (fill in Institution and Location) is called to the following addendum to the (Designer to include here only the applicable item or items such as contract, specifications and/or drawings.) The items set forth herein, whether of omission, addition, substitution or clarification are all to be included in and form a part of the proposal submitted.

THE NUMBER OF THIS ADDENDUM (NO. 1) MUST BE ENTERED IN THE APPROPRIATE SPACE B, PROVIDED AFTER THE WORD "NUMBERED" ON PAGE 2 OF THE CONTRACT FORM ENTITLED "FORM FOR GENERAL BID", AND IN PARAGRAPH B OF THE "FORM FOR SUB-BID."

A. CONTRACT FORM CHANGES:

1. Notice to Contractors
  - a. Page 1 - Change in the fourth paragraph - the date of submittal bids for the General contract from August 15, 1983 to September 1, 1983.

B. SPECIFICATION CHANGES:

1. SECTION 05101 MISCELLANEOUS AND ORNAMENTAL IRON
  - a. Page 05101-7 Article A-5 paragraph 1. DELETE this paragraph in its entirety and substitute the following:

"Units shall have one-piece steel frame heliarc welded, polished, baked matte black finish with no open miters"

## **APPENDIX J (continued)**

### **SAMPLE ADDENDUM SHEET**

C. DRAWING CHANGES:

1. DRAWING A-14

- a. Detail 13, Change 8 ft. - 0 in. dimension for elevator door opening to 7 ft. - 0 in.

END OF ADDENDUM #1

\_\_\_\_\_  
Director, Office of \_\_\_\_\_

## APPENDIX N

### Sustainable Design

#### Introduction

Sustainable design is a multi-disciplinary, integrated approach to construction that uses material, energy, and water resources efficiently, minimizes site impacts, addresses the health issues relating to construction and indoor environments, and supports the use of local products. Sustainable design can be achieved by undertaking collaborative and conscious design and product selection choices and *without* lowering construction quality or aesthetics, increasing costs, or making program sacrifices. Sustainably designed buildings are high performance buildings that meet the fiscal and programmatic responsibilities of the Commonwealth's agencies.

Keeping up with industry standards is an important goal of DCAM, and sustainable design is fast becoming an industry standard to improve design quality. Sustainable design techniques and technologies aim to improve the overall performance and aesthetics of the buildings owned and occupied by the Commonwealth and its citizens, workers, students, and residents. In addition, sustainable design has the potential to have far-reaching impacts related to the local, regional, national and global environment, including slowing global climate change, improving air quality, reducing ozone depletion, and protecting natural resources, among others.

By formalizing sustainable design requirements, Massachusetts affirms its commitment to designing and building high performance buildings. As this field evolves and new technologies, techniques and standards are developed and proven, DCAM will update the information included herein. Furthermore, DCAM encourages designers to take the initiative to propose alternative sustainable design opportunities for potential use in DCAM projects. Through these actions, Massachusetts' public buildings can become a model for practical, achievable, high performance buildings and sustainable design.

In order to meet DCAM's sustainable design requirements, designers should concern themselves with the topics outlined in this appendix. They include the following:

**Section 1:** Requirements by Division

**Section 2:** Process for maximizing utility rebates for conservation measures

**Section 3:** Compliance Energy Conservation requirements of Mass. State Building Code

**Section 4:** Indoor Environmental Quality/Indoor Air Quality (IAQ) Considerations

**Section 5:** Description of Life Cycle Cost Analysis (LCCA)

**Section 6:** Other Sustainable Design Considerations

**Section 7:** References, Information sources, etc.

**Strict requirements in each section are identified in bold print.**

## Section 1: Requirements by Division

The specifications detailed below should be adopted by the designer as standard considerations for all designs, and shall be adhered to in construction documents.

1. **Where any of the below specifications that appear in bold print cannot be met, the designer shall justify, in writing, the need for exception to such specific elements. Alternate designs shall be accepted only where justified for explicit applicability reasons, such as lack of product availability or for specific concerns unique to the project.**
2. **Designers shall ensure that specifications related to product selections can be met by at least three manufacturers.**
3. **Designers shall specify only those products that meet the VOC standards established in the tables published in Section 4 of this Appendix.**
4. **Designers shall document the consideration, during the design process, of recommended items not ultimately selected for inclusion in project.**

<b>Division</b>	<b>Specification</b>
<b>Division 2: Site Work</b>	
02051 Demolition	<ul style="list-style-type: none"><li>• <b>Specify that the maximum practicable amount of construction and demolition waste be recycled or reused and detail a process for contractor or waste hauler to document and verify this during construction/demolition. A minimum of 50% (by weight) rate of recycling or reuse must be achieved.</b></li><li>• <b>Specify that all asphalt, cardboard, brick, concrete, metal, wood, and ceiling tiles (clean) that can be separated, be recycled or reused.</b></li><li>• Consider reusing existing building materials and components whenever possible, especially wood.</li></ul>
02100 Site Preparation & Clearing  (*Refer to available DCAM specification guidelines on Site Preparation & Clearing, whose requirements include those listed here and additional requirements.)	<ul style="list-style-type: none"><li>• <b>Specify maximum protection of existing trees, other vegetation and existing improvements, and require careful stripping and stockpiling of topsoil for reuse in job site landscaping.</b></li><li>• <b>Specify restrictions to vehicular access to the site to meet landscape and site protection goals.</b></li><li>• <b>No burning of materials on the job site will be permitted.</b></li><li>• <b>Specify the use of protective fences as well as adequate shoring and bracing of existing conditions and site amenities that are to remain intact during construction including any structures, retaining walls, and landscaping amenities.</b></li><li>• <b>Specify effective measures to prevent windblown dust and debris from escaping the job site.</b></li><li>• <b>At minimum, a site sediment and erosion control plan should conform to the best management practices in the EPA's Storm Water Management for Construction Activities (EPA</b></li></ul>

	<b>document EPA-833-R-92-001, Chapt. 3) and with other Form 9 requirements.</b>
02500 Paving	<ul style="list-style-type: none"> <li>• Consider using pervious paving materials.</li> <li>• Consider using paving materials made from recycled materials such as glass and plastic.</li> </ul>
02810 Irrigation Systems	<ul style="list-style-type: none"> <li>• <b>Equip irrigation systems with rain sensor overrides.</b></li> <li>• <b>Avoid line pressure misting sprinklers, where possible.</b></li> <li>• Consider submetering irrigation.</li> <li>• Consider capturing rainwater or greywater for irrigation.</li> </ul>
02900 Landscape work	<ul style="list-style-type: none"> <li>• <b>Use plants native to the site in order to reduce the need for soil amendments and excessive water.</b></li> <li>• <b>Minimize use of annuals or lawns.</b></li> <li>• <b>Use hydraulic mulch with 100% post-consumer paper or paper/wood content.</b></li> <li>• Consider use of natural plants and landscaped marshes to treat stormwater runoff from paved surfaces.</li> </ul>
<b>Division 3: Concrete</b>	
03300 and 03400 Cast-In-Place Concrete And Precast Concrete	<ul style="list-style-type: none"> <li>• <b>Where removable formwork is used, specify a biodegradable form release agent.</b></li> <li>• <b>Ensure that specifications do not preclude the use of concrete containing fly ash or ground granulated blast furnace (GGBF) slag, unless the use of these materials is technically inappropriate for a particular construction application.<sup>1</sup></b></li> <li>• <b>When specifying concrete, which contains fly ash or GGBF slag content, provide documentation of percentages utilized.</b></li> </ul>
<b>Division 5: Metals</b>	
05050 Steel and aluminum	<ul style="list-style-type: none"> <li>• <b>Specify steel and aluminum with recycled content of 30% or greater or justify the alternative.</b></li> </ul>
<b>Division 6: Wood &amp; Plastic</b>	
06050 Treated wood	<ul style="list-style-type: none"> <li>• <b>Do not specify wood treated with copper chromium arsenate.</b></li> <li>• Consider using wood and wood products certified as coming from forests that meet internationally recognized principles of forest stewardship as promoted by the Forest Stewardship Council (FSC), such as SmartWood®.</li> </ul>
06600 Fences, decks, and benches	<ul style="list-style-type: none"> <li>• <b>Specify recycled plastic with a minimum of 50% recycled content or wood-recycled plastic composite products or justify the alternatives.</b></li> </ul>

<sup>1</sup> Refer to EPA's Comprehensive Procurement Guidelines- document EPA530-F-00-009. (see <http://www.epa.gov/cpg/products/cement.htm>)

06100 Rough carpentry	<ul style="list-style-type: none"> <li>• <b>Specify composite boards that do not contain urea-formaldehyde binding resins.</b></li> <li>• <b>Specify structural fiberboard with a minimum of 85% post-consumer waste material or justify alternative.</b></li> <li>• <b>Specify laminated paperboard with 100% post-consumer paper.</b></li> </ul>
06400 Architectural woodwork	<ul style="list-style-type: none"> <li>• <b>Specify water-based adhesives and low-VOC adhesives in accordance with the VOC limits established in Sec. 4 of this document.</b></li> <li>• Consider using wood and wood products certified as coming from forests that meet internationally recognized principles of forest stewardship as promoted by the FSC, such as SmartWood®.</li> </ul>
06600 Structural Plastics	<ul style="list-style-type: none"> <li>• <b>Use 100% recycled plastic or other recycled lumber for exterior decking, fencing, parking appurtenances, and outdoor site furnishings, or justify the alternative.</b></li> </ul>
<b>Division 7 - Thermal and Moisture Protection</b>	
07200 Building Insulation	<ul style="list-style-type: none"> <li>• <b>Specify insulation materials made without ozone depleting compounds, including CFCs &amp; HCFCs.</b></li> <li>• <b>Specify insulation with at least 20% recycled material by weight.</b></li> <li>• <b>If using rock wool insulation, specify a minimum of 75% total recovered materials.</b></li> <li>• <b>If using cellulose insulation, specify a minimum of 75% post-consumer recycled content.</b></li> </ul>
07900 Joint Sealants	<ul style="list-style-type: none"> <li>• <b>Specify that sealants that are not formulated with aromatic solvents, halogenated solvents, fibrous talc or asbestos, formaldehyde, mercury, lead, cadmium, hexavalent chromium, or their compounds.</b></li> <li>• <b>Specify sealants that meet the VOC limits stated in Sec. 4 of this Appendix.</b></li> </ul>
<b>Division 8 - Doors and Windows</b>	
08200 Wood Doors	<ul style="list-style-type: none"> <li>• <b>Specify wood doors with core materials that do not contain particleboard made with urea-formaldehyde binders.</b></li> <li>• Consider wood doors certified as coming from forests that meet internationally recognized principles of forest stewardship as promoted by the FSC, such as SmartWood®.</li> </ul>



08800 Glass and Glazing	<ul style="list-style-type: none"> <li>• <b>Use low-e glazings wherever practicable, especially on unshaded South facing aspects.</b></li> <li>• <b>Specify sufficient shading coefficient to prevent unnecessary heat gain.</b></li> <li>• Consider using energy modeling results in the specification of glass &amp; glazing (see Div. 15, below, and Sec. 6 of this document).</li> <li>• Consider using photovoltaic integrated glazing on south facing windows or sunlights.</li> <li>• Consider the use of shading strategies for south facing aspects.</li> <li>• Consider the use of light shelves in concert with glazing to increase the daylight made available to interior spaces.</li> </ul>
<b>Division 9 - Finishes</b>	
09200 Lath and Plaster	<ul style="list-style-type: none"> <li>• <b>Specify plaster with no-VOC-emitting additives, such as epoxy or other resins.</b></li> </ul>
09250 Gypsum Drywall Construction	<ul style="list-style-type: none"> <li>• <b>Specify drywall with facing paper from 100% recycled content, if available, or justify the alternative.</b></li> <li>• <b>Specify the installation of gypsum board with screws rather than laminating with adhesives.</b></li> <li>• <b>Specify paper joint tape rather than fiberglass tape.</b></li> <li>• <b>Specify low-VOC joint compound, according to the Tables in Sec. 4 of this Appendix.</b></li> <li>• <b>When sound attenuation insulation is used in gypsum construction, specify that it be completely encapsulated within partitions and does not occur where particulate matter can enter return air plenums or other recirculation channels.</b></li> </ul>
09300 Tile	<ul style="list-style-type: none"> <li>• <b>Specify ceramic tile with a minimum recycled content of 70%, of which 15% minimum must be post-consumer glass or ceramic.</b></li> </ul>
09510 Acoustic Panel Ceiling	<ul style="list-style-type: none"> <li>• <b>Specify acoustic panel with a maximum recycled content or justify alternatives.</b></li> <li>• <b>Specify ceiling tile products that are free from formaldehyde.</b></li> <li>• <b>Specify ceiling tiles that do not have vinyl faces.</b></li> </ul>
09640 Wood Flooring	<ul style="list-style-type: none"> <li>• Consider wood certified as coming from forests that meet internationally recognized principles of forest stewardship as promoted by the FSC, such as SmartWood®. OR consider "rediscovered" wood products which may include that from: <ul style="list-style-type: none"> <li>• demolition projects for antiquated buildings</li> <li>• dead, fallen, diseased or nuisance trees</li> <li>• orchards where unproductive trees are cut for replacement</li> <li>• fallen trees carefully reclaimed from rivers and lakes</li> <li>• usable wood safely reclaimed from demolition landfills</li> <li>• wood by-products from secondary manufacturers</li> </ul> </li> </ul>

09650 Resilient Flooring	<ul style="list-style-type: none"> <li>• <b>For outdoor rubber matting and gym surfaces, specify a minimum of 50% post-consumer recycled content.</b></li> <li>• <b>For indoor rubber flooring, matting, and gym surfaces, specify a minimum of 15% post-consumer recycled content.</b></li> <li>• In lieu of recycled content requirement noted above, consider rubber flooring, matting, and surfaces made from a minimum of 95% renewable materials.</li> <li>• <b>If specifying vinyl flooring, require 10% recycled content.</b></li> <li>• Consider low-emissivity resilient flooring such as cork.</li> <li>• Consider flooring made from natural products such as linoleum.</li> </ul>
09680 Carpet	<ul style="list-style-type: none"> <li>• <b>Specify that carpeting products be approved by the Carpet and Rug Institute IAQ Testing Program and carry the approved logo.</b></li> <li>• <b>Avoid carpets with backing made from styrene butadiene latex, which is a primary emitter of 4-phenylcyclohexene (4-PC).</b></li> <li>• <b>If carpets are virgin, avoid vinyl backed carpets.</b></li> <li>• <b>If using broadloom or tile (modular) carpeting, specify a minimum recycled content of 10%.</b></li> <li>• <b>Specify carpet with recycled backing.</b></li> <li>• <b>Specify Entry Carpet Matting with a minimum of 50% post-consumer recycled rubber.</b></li> <li>• <b>Specify Food Service Matting with a minimum of 50% post-consumer recycled rubber.</b></li> <li>• <b>For renovations, specify that any carpet removed shall be recycled by closed loop recycling or recycling into feedstocks, unless unfeasible due to contamination.</b></li> <li>• <b>Specify that carpet scraps be put into a recycling or reuse program.</b></li> <li>• <b>Keep carpet away from entranceways to avoid moisture and dirt build-up.</b></li> <li>• <b>Specify that the installation of the carpet must meet with the Carpet and Rug Institute's <i>Standard for Installation of Commercial Carpet CRI-104</i> on use of solvent adhesive removers. Liquid adhesive removers cannot be used to remove carpet replaced under this bid.</b></li> </ul>
09720 Wall Coverings	<ul style="list-style-type: none"> <li>• <b>Do not specify vinyl wall coverings.</b></li> <li>• Where wall coverings are to be used, consider the use of natural wall coverings such as sisal, jute, or cork.</li> </ul>
09840 Acoustical Wall Panels	<ul style="list-style-type: none"> <li>• <b>Avoid vinyl-faced acoustical wall panels.</b></li> <li>• <b>Specify wall panels that are manufactured without formaldehyde.</b></li> <li>• <b>Specify installation methods that do not use adhesives.</b></li> <li>• Consider recycled content wall panels.</li> </ul>

09910 Paint	<ul style="list-style-type: none"> <li>• <b>Specify water-based paints. If using alkyd-base, please justify.</b></li> <li>• <b>Specify zero- or low-VOC paints and primers of VOC content not to exceed that identified in <u>Section 4 Table D, below</u>.</b></li> <li>• <b>Where solvent-based paints, high performance acrylic coatings, pigmented acrylic sealers, or epoxy coatings are necessary, specify VOC levels which meet the standards in identified in <u>Section 4, Table A, below</u>.</b></li> <li>• <b>For flats and non-flat paints, <u>either specify GreenSeal<sup>0</sup> approved paints, or meet ALL the following requirements:</u></b> <ul style="list-style-type: none"> <li>• <b>Water-based paints shall not contain more than 1.0% by weight of the sum total of aromatic compounds.</b></li> <li>• <b>Paints shall not be formulated with formaldehyde, halogenated solvents, mercury or mercury compounds, or tinted with pigments of lead, cadmium, chromium VI, antimony and their oxides.</b></li> <li>• <b>Paints shall be formulated without methylene chloride, toluene, ethyl benzene, vinyl Chloride, naphthalene, 1,2-dichlorobenzene, phthalates, isophoron, 1,1,1-trichloroethane, methyl ethyl keton, methyl isobutyl ketone, acrolein, acrylo-nitrile and ethylene glycol, all of which pose threats to human health.</b></li> </ul> </li> </ul>
09930 Stains and Varnishes	<ul style="list-style-type: none"> <li>• <b>Specify products which meet the VOC standards established in <u>Section 4, Table A</u>.</b></li> <li>• <b>Specify water-based stains and transparent finishes wherever practicable.</b></li> <li>• <b>Consider using natural stains and varnishes which are made without the use of petrochemical products.</b></li> </ul>
09980 Coatings for Concrete	<ul style="list-style-type: none"> <li>• <b>Specify that water-based penetrating concrete coatings meet the VOC standards established in <u>Section 4, Table A</u>.</b></li> </ul>
<b>Division 10 - Specialties</b>	
10160 Toilet Compartments	<ul style="list-style-type: none"> <li>• <b>Specify solid plastic toilet compartments/partitions fabricated from recycled high density polyethylene (HDPE).</b></li> </ul>
<b>Division 11 - Equipment</b>	
11450 Appliances	<ul style="list-style-type: none"> <li>• <b>Specify energy efficient and water saving appliances. Check with local utility for rebates available for high efficiency equipment, &amp; specify products that meet such criteria, where they exist.</b></li> <li>• <b>Specify “Energy Star” approved appliances.</b></li> <li>• <b>Specify that appliances shall not contain mercury switches, and that gas appliances with standing pilot lights shall contain an electric ignition.</b></li> </ul>

<b>Division 12 Furnishings</b>	
12800 Planters	<ul style="list-style-type: none"> <li>Specify plastic planters fabricated from recycled high density polyethylene (HDPE).</li> </ul>
<b>Division 13 - Special Construction</b>	
13175 Ice Skating Rinks	<ul style="list-style-type: none"> <li>Ice Skating Rinks shall be designed with maximum energy efficiency including but not limited to: <ul style="list-style-type: none"> <li>low-e ceilings</li> <li>premium efficient motors</li> <li>heat exchangers</li> <li>energy management and control systems</li> <li>liquid pressure amplifiers</li> </ul> </li> </ul>
13165/13170 Pools	<ul style="list-style-type: none"> <li>Designers of pools at educational facilities must comply with MGL Ch. 164, § 331 (as amended) that requires DCAM to evaluate the use of solar or other renewable energy systems as the primary energy source for hot water.</li> <li>Pool designs should include specification of a pool cover system.</li> </ul>
Educational facilities (domestic water heating)	<ul style="list-style-type: none"> <li>Designers of educational facilities with a demand for hot water in excess of 1000 gallons per day must comply with MGL Ch. 164, § 331 (as amended) that requires DCAM to evaluate the use of solar or other renewable energy systems as the primary energy source for hot water.</li> </ul>
Laboratories	<ul style="list-style-type: none"> <li>Evaluate fume hood controls and associated variable air volume systems for laboratories.</li> </ul>
<b>Division 14 - Conveying Systems</b>	
14200 Elevators	<ul style="list-style-type: none"> <li>Evaluate elevator shafts as sources of radon and remediate where levels are in excess of applicable standards.</li> <li>Consider using high-speed elevators with variable frequency drives.</li> </ul>
<b>Division 15 - Mechanical</b>	
15400 Plumbing	<ul style="list-style-type: none"> <li>Public toilet room sink fixtures shall not exceed 0.5 GPM @ 80 PSI.</li> <li>Showerhead fixtures shall be low flow type, maximum 2.5 GPM @ 80 PSI.</li> <li>All new toilets shall be a maximum 1.6 GPF.</li> <li>Existing toilets should be retrofit with valve retrofit kits wherever possible.</li> <li>Specify waterless urinals, or justify the alternative.</li> <li>Consider infrared sensors for automated faucet control.</li> <li>Consider the use of composting toilet systems where practicable. Consider using bubble troll or sonic wave mechanisms in septic tank pumps instead of mercury float switches.</li> </ul>

15050/15900 HVAC	<ul style="list-style-type: none"> <li>• <b>Evaluate HVAC system(s) and component selection with life cycle cost analysis and specify least cost products, considering capital and operating costs (factor-in any available utility rebates). See Section 5 of this Appendix for further direction.</b></li> <li>• <b>Specify only high efficiency heating and cooling equipment, including all boilers, chillers, pumps, motors, and related items.</b></li> <li>• <b>Specify variable frequency drives wherever they enhance system performance.</b></li> <li>• <b>Install heat exchanger systems, whenever possible.</b></li> <li>• <b>Use Federal Energy Management Program standards for air conditioners as a minimum efficiency guide.</b></li> <li>• <b>Specify energy &amp; water efficient cooling towers (with delimiters to reduce drift and evaporation).</b></li> <li>• <b>Install only mercury-free thermostats, switches, and gauges in all mechanical and electrical equipment.</b>  <b>-If mercury-free items are not available, ensure that all mercury containing parts must be clearly labeled with durable labels as to mercury content.</b></li> <li>• <b>If renovating an existing building or HVAC system, meter the actual load of the building to assist in design of the new system or component.</b></li> <li>• <b>For projects exempt from the State Energy Code, 780 CMR 13, at minimum, meet ASHRAE/IESNA 90.1, 1999.</b></li> <li>• <b>Do not use any CFC-based refrigerants in new base building HVAC and Refrigeration systems. If reusing exiting base building HVAC equipment, complete a comprehensive CFC phaseout conversion.</b></li> <li>• <b>Conduct feasibility-level life cycle cost analyses (LCCA) for applicable renewable energy systems during the study phase.</b></li> <li>• <b>Consider low-flow, high temperature differential (delta-T) chilled and condenser water systems in conjunction with low temperature air distribution as means to reduce pipe, pump, and ductwork sizes and reduce operating costs.</b></li> <li>• <b>Consider low air temperature air distribution when using direct expansion systems.</b></li> <li>• <b>Consider utilizing HVAC products that are in the top 25% of their class regarding energy efficiency – or that are at least 10% better than established minimum efficiency standards for the product class (i.e., ASHRAE Standard 90.1-1999)</b></li> <li>• <b>Consider air to air or desiccant heat exchangers.</b></li> <li>• <b>Consider direct digital control energy management and control systems (DDC/EMCS).</b></li> <li>• <b>Consider noise effects of HVAC system components related to the delivery of conditioned air in the design of HVAC systems.</b></li> </ul>
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15050/15900 HVAC (cont.)	<ul style="list-style-type: none"> <li>• Consider alternatives to the use of HCFCs as refrigerants where such alternatives are more energy efficient and result in lower life cycle cost. In either case, use US EPA-approved refrigerants.</li> <li>• Consider specifying that HVAC duct work be delivered to the site with caps to prevent contamination during construction.</li> <li>• Consider inclusion of occupancy sensors and/or CO<sub>2</sub> sensors in rooms with intermittent or highly variable occupancy levels. See Section 6 of this Appendix.</li> <li>• Consider underfloor displacement ventilation system as alternative to hung ceilings and overhead ductwork. Evaluate such systems on basis of LCCA.</li> </ul>
<b>Division 16 - Electrical</b>	
16500 Lighting	<ul style="list-style-type: none"> <li>• <b>Evaluate lighting design with life cycle cost analysis and specify least cost products when considering capital and operating costs (factor-in any available utility rebates), see Sec. 5 of this Appendix.</b></li> <li>• <b>Evaluate automatic daylight dimmers in LCCA, see Sec. 5.</b></li> <li>• <b>Do not exceed the Illuminating Engineering Society of North America (IESNA) footcandle level requirements as stated in the Recommended Practice Manual: Lighting for Exterior Environments.</b></li> <li>• <b>Design interior and exterior lighting such that zero direct-beam illumination leaves the building site (property).</b></li> <li>• <b>Maximize daylight harvest by specifying dimmable ballasts &amp; photosensors.</b></li> <li>• Consider the integration of additional daylight considerations such as the use of vertical fenestration, light shelves, monitors, clerestories, photosensors, high albedo ceilings and wall coverings, transparent interior partitions, and evaluation of glass/glazing light transmittance and window design.</li> <li>• Consider solar-powered exterior lighting (especially for remote areas, large parking lots, etc.).</li> <li>• <b>The following guidelines must be adopted for site-specific lighting applications.</b> <ul style="list-style-type: none"> <li><u>Interior lighting</u></li> <li>• <b>Specify fluorescent rather than incandescent lighting.</b></li> <li>• <b>Specify combinations for T-5s, T-8s, compact fluorescents, and electronic dimmable ballasts (with system-integrated photosensors for perimeter/windowed areas).</b></li> <li>• <b>Specify only LED Exit signs.</b></li> <li>• When HID lights are needed, consider 2 stage switching.</li> <li>• Consider impact of lighting (and other internal building loads) on HVAC system design.</li> </ul> </li> </ul>

	<p><u>Exterior lighting</u></p> <ul style="list-style-type: none"> <li>• <b>Specify metal halide or high pressure sodium lamps for general purpose exterior lighting.</b></li> <li>• <b>Equip exterior lighting with photosensors.</b></li> </ul> <p><u>Emergency lighting</u></p> <ul style="list-style-type: none"> <li>• <b>Specify LED (Light-emitting diode) exit signs.</b></li> </ul>
<b>Divisions 14,15 &amp; 16 – re: Motors</b>	
	<ul style="list-style-type: none"> <li>• <b>Evaluate motors and drives based on life cycle cost analysis and specify premium efficient motors and variable speed drives (VSDs) wherever possible. Seek utility rebates for high- or premium efficient motors and drives wherever possible.</b></li> </ul>

## Section 2: Process for maximizing utility rebates for energy efficient measures

Most electric and gas utility companies offer energy management programs (a.k.a., demand side management, DSM) to help customers design and install energy efficient equipment. These programs offer rebates to customers as incentives to increase efficiency above what would be considered “standard” efficiency. Each utility offers a different set of rebate programs that are subject to change; **designers MUST contact utilities to ascertain information on the current programs.**

In general, projects can receive rebates for the following types of efficiency measures for both renovation and new construction projects:

### **Electric**

- Efficient lighting
- Efficient heating (not likely)
- Efficient air conditioning
- Efficient water-cooled chillers
- Efficient cooling towers
- Ground or water source heat pumps
- Window glazing to reduce cooling load
- Premium efficiency motors
- Variable speed drives
- Variable air volume systems
- Fume hood controls
- Energy Management and Control Systems (EMS/ECS)

### **Gas**

- Switching to gas from another fuel
- Efficient space heating and controls
- Efficient air conditioning
- Efficient water heating
- Innovative technology demonstration
- Building envelope & design modeling
- Development in economic development zones

In addition, the utilities often provide design assistance to help design, model, and specify energy efficient systems and system components. Such “comprehensive design assistance,” or “technical assistance” programs, are usually conducted on a cost share basis and are typically available only for larger projects. Projects pursued with such utility assistance typically receive larger total rebates than projects addressed with only “prescriptive” rebate programs.

**All design teams (MEP consultants) shall facilitate DCAM/user agency’s participation in all applicable utility rebate programs. The following steps are required to maximize utility rebates:**

1. The designer will make the first contact with the electric and gas utilities to determine the standards required for rebates and determine whether applicable building systems or components qualify for prescriptive or comprehensive rebates.
2. The designer shall evaluate all rebatable systems based upon life cycle cost analysis inclusive of capital costs, operating, maintenance and energy costs and the availability of rebates for equipment meeting various efficiency levels.
3. The designer will specify those systems and/or system components that exhibit the least life cycle cost (on a net present value [NPV] basis) given expected utility rates, O&M costs, capital costs, anticipated rebates and reasonable interest and discount rates.



4. The designer will be responsible for filling-out and submitting rebate forms to the utilities offering rebates based on those systems that exhibit the most favorable life cycle costs.
5. Letters of commitment or intent from the utilities as to the anticipated rebates shall be received by DCAM project management and copied to contractors who will be recipient of utility rebate fund checks.
6. After installation of systems, utilities will check installations and then issue rebate checks. Checks will be made payable to contractors. Upon contractors' receipt of utility rebate checks, contractor will issue a credit change order for same amount to DCAM in order for rebates to flow back into project budget. (No overhead & profit or other administrative fee shall be allowed to be taken by the contractor. In the case of BHE facilities, the utilities may cut checks of issue credits directly to the facility if the facility so chooses.)
7. DCAM Energy Team staff will be available for facilitation of rebates and process issues including assistance to designers, facilitation of energy modeling, communicating with utilities, transmittal of commitment letters and collection of funds from contractors.

To ensure that all eligible rebates are collected, DCAM Energy Team will work with the design team to help determine if utility rebates are available. The DCAM Energy Team will facilitate collaboration with applicable utilities to determine whether prescriptive or comprehensive (custom) rebates are available. **The design team will be responsible for filing all necessary paperwork to obtain utility rebates.**

### Section 3: Compliance with Energy Conservation requirements of Massachusetts State Building Code

**The designer is responsible for documenting that all aspects of the project design meet or exceed the Energy Conservation requirements of the Massachusetts State Building Code (780 CMR, Chapter 13).** The Code dictates a number of important energy conservation requirements for new buildings in Massachusetts.

**N.B. The design team must notify DCAM if a project is not required to meet the current energy code.** In such cases, other options for improving energy efficiency should be explored. Section 1, above, details requirements that must be met, even for exempt projects.

## Section 4: Indoor Environmental Quality/Indoor Air Quality (IAQ) Requirements

**All designs must meet the minimum requirements of voluntary consensus standard ASHRAE 62-1999, Ventilation for Acceptable Indoor Air Quality and approved Addenda.<sup>2</sup>**

The designer shall take all possible steps to ensure that the building's indoor environment (including, but not limited to air quality) is safe and healthy. Mechanical designers should exercise deliberate care to ensure that achieving thermal comfort and desired relative humidity control be done in a fashion which ensures that adequate ventilation and distribution of air is achieved and that airborne contaminants and potential toxins are not introduced to ventilation air.

There are many strategies for achieving these goals including adherence to the relevant regulations and standards regarding air changes and system operation.

**Among the strategies that designers should consider to ensure good indoor air quality are:**

1. Evaluation and isolation of potential sources of contamination.
2. Careful humidity control (though, not necessarily active humidification).
3. Avoidance of exposure to airborne pollutants (such as from offgassing of volatile organic compound (VOC) containing materials, cleaning solvents and pest control).
4. The utilization of carbon dioxide monitors to ensure that adequate ventilation, a basic requirement for IAQ, is provided to occupied spaces.

### **VOCs, Additional Chemical Compound Limits, & Potential IAQ Pollutant Sources**

To help avoid contamination of the indoor environment from architectural products, the designer should specify architectural products that contain low levels of VOCs and various additional chemical compounds. VOC emissions rates and various additional chemical compound limits of designated materials should be obtained from information available from the manufacturer and from Material Safety Data Sheets (MSDS). At the discretion of DCAM staff, designers may be expected to submit MSDS for those specified products for which such information exists.

**The following tables provide information on the maximum VOC content for architectural coatings, adhesives and sealants. Materials specified by designers shall not exceed these limits for any products to be utilized in DCAM projects.** These rates have been scientifically determined and approved by the South Coast Air Quality Management District of California,<sup>3</sup> Greenseal,<sup>4</sup> and the Carpet and Rug Institute<sup>5</sup> to protect human health and the environment. The US Green Building Council has also accepted these as baseline standards.<sup>6</sup>

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<sup>2</sup> ASHRAE Standard 62-1999: Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Atlanta, GA 30329.

<sup>3</sup> For more information, see South Coast Air Management District (SCAQMD) at: <http://www.aqmd.gov>

<sup>4</sup> For more information, see Greenseal at: <http://www.greenseal.org/standard/paints.htm>

<sup>5</sup> For more information, see the Carpet & Rug Institute at: <http://www.carpet-rug.com/>

<sup>6</sup> For more information, see The US Green Building Council at: <http://www.usgbc.org/>

**Table A: VOC Limits – ARCHITECTURAL COATINGS<sup>7</sup>**

<b><u>COATING</u></b>	<b><u>Limit VOC, Grams Per Liter<sup>8</sup></u> <u>(Less Water and Less Exempt Compounds)</u></b>
Bond Breakers	350
Chemical Storage Tank Coatings	420
Clear Wood Finishes:	
Varnish	350
Sanding Sealers	350
Lacquer	550
Concrete-Curing Compounds	350
Dry-Fog Coatings	400
Essential Public Service Coating	420
Fire-proofing Exterior Coatings	350
Fire-Retardant Coatings:	
Clear	650
Pigmented	350
Paints (Latex)	
Interior Flats <sup>9</sup>	50
Interior Non-Flats	150
Exterior Flats	100
Exterior Non-Flats	200
Floor Coatings	100
Graphic Arts (Sign) Coatings	500
High Temperature Industrial Coatings	420
Industrial Maintenance Coatings	250
Japans/Faux Finishing Coatings	350
Magnesite Cement Coatings	450
Mastic Coatings	300
Metallic Pigmented Coatings	500
Multi-Color Coatings	250
Pigmented Lacquer	550
Pre-Treatment Wash Primers	420
Primers, Sealers, and Undercoaters	200
Quick-Dry Enamels	250
Quick-Dry Primers, Sealers, and	200
Recycled Coatings	250

<sup>7</sup> For more information, see SCAQMD Rule 1113: <http://www.aqmd.gov/rules/html/r1113.html>

<sup>8</sup> VOC concentrations determined by US EPA Reference Test Method 24, Code of Federal Regulations, Title 40, Part 60, Appendix A.

<sup>9</sup> For more information, see GreenSeal at <http://greenseal.org/standard/paints.htm>

<b><u>COATING</u></b>	<b><u>Limit VOC, Grams Per Liter<sup>8</sup></u> <b><u>(Less Water and Less Exempt Compounds)</u></b></b>
Roof Coatings	250
Bituminous Roof Coatings	250
Rust Preventative Coatings	400
Shellacs:	
Clear	730
Pigmented	550
Specialty Primers	350
Stains	250
Swimming Pool Coatings:	340
Traffic Coatings	150
Waterproofing Sealers	250
Wood Preservatives	
Below-Ground	350
Other	350

**Table B1: VOC Limits – ADHESIVES<sup>10</sup>**

<b><u>SUBSTRATE</u></b>	<b><u>Limit VOC, Grams Per Liter</u> <b><u>(Less Water and Less Exempt Compounds)</u></b></b>
Non-Vinyl Backed	150
Carpet Pad Installation	50
Wood Flooring Installation	100
Ceramic Tile Installation	65
Dry Wall and Panel Installation	50
Subfloor Installation	50
Rubber Floor Installation	60
VCT and Asphalt Tile Installation	50
PVC Welding	510
CPVC Welding	490
ABS Welding	400
Plastic Cement Welding	510
Cove Base Installation	50
Adhesive Primer for Plastic	650
Multipurpose Construction	70
Structural Glazing	100
Single-Ply Roof Membrane	250
Adhesive Primer for Traffic Marking	150

<sup>10</sup> For more information, see SCAQMD Rule 1168: <http://www.aqmd.gov/rules/html/r1168.html>

For adhesives, adhesive bonding primers, or any other primers not listed above but applied to the following substrates, the following limits shall apply (Table B2):

**Table B2: VOC Limits – ADHESIVES<sup>11</sup>**

<b><u>SUBSTRATE</u></b>	<b><u>Limit VOC, Grams Per Liter (Less Water and Less Exempt Compounds)</u></b>
Metal to Metal	30
Plastic Foams	50
Porous Material (except wood)	50
Wood	30
Fiberglass	80

\*If an adhesive is used to bond dissimilar substrates together the adhesive with the highest VOC content shall be allowed.

**Table C: VOC Limits – SEALANTS<sup>12</sup>**

<b><u>SEALANTS</u></b>	<b><u>Limit VOC, Grams Per Liter (Less Water and Less Exempt Compounds)</u></b>
Architectural	250
Marine Deck	760
Nonmembrane Roof	300
Roadway	250
Single-Ply Roof Membrane	450
Other	420
<b><u>SEALANT PRIMERS:</u></b>	
Non Porous	250
Porous	775
Modified Bituminous	500
Marine Deck	760
Other	750

<sup>11</sup> For more information, see SCAQMD Rule 1168: <http://www.aqmd.gov/rules/html/r1168.html>

<sup>12</sup> For more information, see SCAQMD Rule 1168: <http://www.aqmd.gov/rules/html/r1168.html>

**Table D: VOC Limits – CARPET PRODUCTS**

DCAM has adopted The Carpet and Rug Institute's (CRI) quality assurance and indoor air quality standards for meeting its Green Label "Seal of Approval" emblem. CRI's test methodology for VOCs was developed by consensus during an official dialogue with the EPA and has been adopted by the American Society for Testing and Materials (ASTM) as *D 5116 – Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products*. **All carpet products specified for installation should meet these standards, as outlined in the table below** (note - these VOC levels are based on off-gassing emissions, not grams/liter content)<sup>13</sup>:

<b>CRI criteria are based on a maximum emission factor measured in mg/m<sup>2</sup>·hr as follows:</b>	
Total Volatile Organic Compounds	0.5
4-PC (4-Phenylcyclohexene)	0.05
Formaldehyde (to prove that none is used)	0.05
Styrene	0.4

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<sup>13</sup> For more information, see the Carpet & Rug Institute at: <http://www.carpet-rug.com/>

### **Additional Chemical Compound Limits**

In addition to the VOC limits expressed in the above tables, DCAM has adopted limits regarding potentially hazardous chemical components as follows (these have been adopted by Greenseal<sup>14</sup> and are referenced as minimum standards by the US Green Building Council):

- 1. None of the paint and coating products listed above can contain aromatic compounds composing more than 1.0% by weight of the sum total of the product.**
- 2. Chemical Component Limitations - Other Chemicals: paint and coating products specified will not contain or utilize any of the following chemical compounds in the manufacture of the product.**
  - Halomethanes: methylene chloride
  - Chlorinated ethanes: 1,1,1-trichloroethane
  - Aromatic solvents: benzene, toluene (methylbenzene), ethylbenzene
  - Chlorinated ethylenes: vinyl chloride
  - Polynuclear aromatics: naphthalene
  - Chlorobenzenes: 1,2-dichlorobenzene
  - Phthalate esters: di (2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, di-n-octyl phthalate, diethyl phthalate, dimethyl phthalate
  - Miscellaneous semi-volatile organics: isophorone
  - Metals and their compounds: antimony, cadmium, hexavalent chromium, lead, mercury
  - Preservatives (antifouling agents): formaldehyde
  - Ketones: methyl ethyl ketone, methyl isobutyl ketone
  - Miscellaneous volatile organics: acrolein, acrylonitrile
- 3. All paint cans and products must not be fabricated with lead.**
- 4. None of the adhesive products listed above may be formulated with any carcinogens<sup>15</sup>, reproductive toxins<sup>16</sup>, persistent bioaccumulative and toxic compounds<sup>17</sup>, or ozone depleting substances<sup>18</sup> as specified in the Greenseal commercial adhesives product standard.<sup>19</sup> Any of these substances known to be present as a contaminant shall not exceed 0.1% by weight of the adhesive product.**

\*N.B. As with all products, designers shall ensure that at least three manufacturers can meet any specification.

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<sup>14</sup> For more information, see Green Seal – Product Standards and Certification for paints and adhesives at: <http://www.greenseal.org/standards.htm>

<sup>15</sup> For more information, see the International Agency for Research on Cancer (IARC) at <http://monographs.iarc.fr/monoeval/grlist.html>

<sup>16</sup> For more information, see the California Office of Environmental Health Hazard Assessment at: [http://www.oehha.org/prop65/prop65\\_list/files/31403LSTA.pdf](http://www.oehha.org/prop65/prop65_list/files/31403LSTA.pdf)

<sup>17</sup> For more information, see the EPA at: <http://www.epa.gov/fedrgstr/EPA-WASTE/1998/November/Day-09/f29952.htm>

<sup>18</sup> For more information, see the EPA at: <http://www.epa.gov/ozone/ods.html>.

<sup>19</sup> For more information, see Green Seal Product Standards at: <http://www.greenseal.org/standards/commercialadhesives.htm>.



## Section 5: Life Cycle Cost Analysis (LCCA) Requirements

Life cycle cost analysis (LCCA) estimates the true cost of a building, or its components, over its anticipated lifetime. LCCA includes the initial capital cost, as well as operation and maintenance costs calculated in present value. **The design team is expected to undertake LCCA to justify design decisions.**

**MGL Ch. 149 Section 44m and MGL Ch. 164 Section 331 require the Division of Asset Management to consider the life-cycle cost of implementing energy efficient and water conserving technologies, including the use of renewable fuels, in new construction or major renovation projects.** MGL Ch. 164 Section 331 requires DCAM to “design and construct [a] facility to minimize the life-cycle cost of the facility by utilizing energy efficiency, water conservation, or other renewable energy technologies...”

This LCCA will evaluate building components that have a bearing on energy use and resource efficiency, including, but not limited to: building envelope, HVAC systems, heat recovery systems, motors and drives, variable air volume systems, cooling towers, lighting, controls, possibly renewables, and some sustainable building materials.

**The study team should identify measures that warrant LCCA in the certified study.** Absent this designation in the study, DCAM’s Energy Team will identify the measures soon after the Partnering/B-conference. DCAM expects that design teams are familiar with the basic economic analysis required to perform LCCA. The Energy Team will be available to guide and facilitate this process with the design team principals. **All LCCA should be completed by the end of Design Development.**

The list of measures for which LCCA will be performed may be revised by the design team in consultation with DCAM. LCCA will include the elements discussed below. Results of the LCCA will be discussed by the design team and DCAM in determining the final design.

### Life Cycle Cost Analysis Requirements

#### Systems/Equipment

Life cycle cost analysis (LCCA) is to be performed for a variety of major building systems to evaluate the life cycle costs of owning and operating systems of alternate specifications. For each measure, a minimum of three alternatives should be evaluated. Typically, these options will be for similar-performing items of different efficiencies or configurations such as various fuel types (e.g., gas chillers as well as electric) or technology types (e.g., evaporative vs. air-cooled condensers). Alternately, systems of considerably different design, which are functionally similar, may be evaluated and compared as design alternatives (e.g., ground source heat pumps vs. standard boilers and a/c or rooftop units).

#### Cost Factors

The analysis should include capital, maintenance and energy costs as well as any rebates that might be available from the electric and/or gas utilities for high efficiency equipment. Capital

costs are to reflect the full installed price and available rebates. Maintenance costs are to be estimated on an annual basis and should be subject to an annual escalation rate (typically 3-4%). Energy costs ought to also reflect price escalation (typically 4%) to account for uncertainty in the energy markets and the potential for future increases in energy costs. Both estimated construction costs, and a net present value (NPV) of capital plus energy and O&M costs ought to be calculated for the expected life of the measure (typically 20 years for most building systems like lighting and HVAC). Annual discount rates of 4% and/or 7% should be applied to discount out-year future cash flows.

#### Other Considerations

Systems which present the least cost in net present value terms and demonstrate simple payback of 12 years or less are to be specified unless extraneous or additional considerations provide significant overriding concern (e.g., system won't fit in space provided; only one manufacturer provides product type specified (proprietary); system LCCAs are close in value (in NPV); or simple paybacks are inordinately lengthy).

#### Data Needs and Related Considerations

LCCAs ought to include the following items:

- Description of options (including size & efficiency level of equipment)
- Hours of operation including annual seasonal variability
- Initial estimated construction cost (equipment, additional design, installation and associated costs)
- Utility rebates, where available
- Energy usage & costs expected per year or season for product/system based on operating hours and heating/cooling degree days particular to the job. LCCA will typically be calculated for a 20 year period for most major building systems, and should include energy price escalation rate of 4%/year)
- Maintenance costs on an annual basis (including any additional training, etc)
- Net cost per year in net present value (NPV) terms to show costs expected from procuring and operating system for the life of the equipment (typically calculated at 20 years)
- Other factors (positive and negative) to be considered (e.g., space considerations, etc.) which will affect the availability or applicability of alternate options or design schemes.

## Section 6: Other Sustainable Design Requirements and Considerations

A large number of other sustainable design considerations ought to be weighed by design teams for inclusion in designs. A few of those, which do not fit the categories discussed earlier in this document, are discussed briefly below. This limited list is not a complete list of such design considerations, but it serves as a list of some of the sustainable design considerations which DCAM would like designers to examine.

Representatives of DCAM's Office of Construction Services will be available to design teams to help facilitate all sustainable design considerations. DCAM additionally reserves the right to provide sustainable design guidance to design teams for systems and features not discussed here.

### **Bicycle commuter:**

Designers should develop amenities in buildings that encourage bicycle commuting, unless justification is provided otherwise. Such designs ought to include bicycle parking and locking facilities and appropriate shower and locker facilities for staff, students or other occupants who might utilize such means of travel to the building.

### **Design for recycling:**

Designers should provide dedicated areas for recyclables collection, including bins, chutes and other accommodations, as well as, safe areas for storing fluorescent lights to be recycled, to promote ease of waste management and recycling.

### **Energy modeling:**

Designers shall utilize whole building energy modeling and performance evaluation software to study, understand, and design for the interactions between various building systems for new buildings and major renovation projects. Such evaluations should consider the effects of lighting, office machines, sunlight & weather, building envelope & windows, as well as occupants' building use and occupancy patterns on the building as a whole and on the HVAC system in particular. Building management and controls systems should account for these effects and feedbacks in order to ensure proper building operations and management.

### **Construction and demolition waste:**

In addition to the specifications detailed in Section 1 above, designers should specify that contractors should employ effective strategies for the separation and recycling of construction and demolition (C&D) wastes for all projects. Such strategies should include the separation and diversion to qualified recyclers and processors of any and all materials that can safely and effectively be reused or processed for recycling. There are a number of organizations that can provide additional support and guidance to that process; it is suggested that contractors contact these entities for technical assistance in dealing with C&D wastes. (e.g., DEP, Boston Building Materials Cooperative, Inc. & Building Materials Resource Center).

### **Daylighting/Sun control:**

Whenever possible, designers should seek to orient occupied building space toward natural light sources and incorporate daylighting into the building as the preferred mode of interior illumination. Natural daylighting, in conjunction with the lighting design will prove

rewarding to the building's energy budget and to the productivity and wellbeing of building occupants. Overheating of internal spaces should be avoided by utilizing glass with sufficient shading coefficient as well as through proper thermal massing or shading.

#### Environmentally preferable materials:

In addition to selection of architectural products and other materials which demonstrate low levels of VOC content or offgassing potential, designers should consider the maximum use of environmentally preferable products. Such products might include high levels of recycled-content materials, such as recycled plastic toilet partitions or outdoor benches, use of local or regional resources, specification of wood from sustainably harvested, certified sources, and the avoidance of products which use ozone-depleting compounds such as in foam products or refrigerants, or toxic ingredients such as in adhesives, finishes, and coatings. (Note: US EPA Approved class II HCFC refrigerants may be used when they prove more energy efficient and result in lower total life cycle cost than other refrigerant alternatives.)

#### Commissioning:

Designers should work with DCAM project management to consider the need for commissioning procedures and protocols in the design, construction, acceptance and occupancy phases of the project. DCAM project management should be consulted regarding commissioning plans, as the depth of commissioning required by facilities will vary relative to the complexity of the project. Commissioning activities may be performed via a number of different delivery mechanisms. Responsibilities for commissioning may fall to the designers, contractors, and/or an independent third-party commissioning agent. Of course, it is expected that all buildings perform effectively, efficiently and according to design intent, regardless of the nature or depth of the commissioning program.

#### IAQ monitoring:

In addition to complying with the IAQ requirements described in Section 4 of these guidelines, designers should consider specifying the use CO<sub>2</sub> monitoring. Since the delivery of a minimum level of outdoor air for ventilation is a basic requirement for the achievement of Acceptable Indoor Air Quality (IAQ),<sup>20</sup> good IAQ cannot be achieved unless this ventilation rate is provided. The delivery of more generous amounts of ventilation, above this minimum rate, has also been shown to increase worker productivity by reducing absenteeism.<sup>21</sup> Therefore, to achieve proper IAQ, it is important that the proper rate of ventilation be determined and maintained over the life of the building at the rate that is appropriate for the activities performed there.

CO<sub>2</sub> monitoring facilitates the optimization of HVAC by providing feedback on the actual amount of ventilation provided. The goal is to ensure that adequate ventilation is provided while energy is not wasted on inappropriate ventilation. ASTM standard D 6245-98 should be consulted

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<sup>20</sup> ASHRAE Standard 62-1999: Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Atlanta, GA 30329.

<sup>21</sup> Milton, Glencross & Walters. Risk of Sick Leave Associated with Outdoor Air Supply Rate, Humidification, and Occupant Complaints. Indoor Air 2000; 10: 212-221. Indoor Air, ISSN 0905-6947. While the costs and benefits of improving ventilation can vary from building to building, this research reports that the costs of providing increased ventilation will be less than 20% of the overall benefit as observed by reduced absenteeism due to improved IAQ.

for guidance on the design of an indoor CO<sub>2</sub> monitoring system.<sup>22</sup> The monitoring of absolute humidity (dew point) can be additionally utilized in order to assess the performance of humidity control systems. The monitoring of carbon monoxide (CO) can also be added to assess the effectiveness of the capture, removal and isolation of air contaminants generated from motor vehicles at loading docks or basement garages.

Site and design planning:

In addition to those requirements outlined in Section 1 of these Guidelines, designers should seek to analyze site resources and building orientation to both conserve and restore ecological resources and maximize ability of natural systems to aid in meeting building performance. Such goals could be accomplished through a number of design considerations, including utilization of daylighting, passive solar strategies, and employing landscape considerations protective of the natural environment. Additionally, designers should seek to carefully redevelop brownfield sites and maximize preservation of open space whenever possible and practicable.

Water-using products and water conservation:

In addition to those items listed above in Section 1 (Division 15400, Plumbing), designers should seek to minimize the use of fresh water in the building as well as minimizing the discharge of water effluents in the waste stream. Strategies to achieve this goal might include the specification of automatic shut-offs or infrared sensors for bathroom fixtures, the use of native perennials in the landscape design as opposed to water-intensive lawns, the potential design of greywater systems or rainwater collection for site irrigation, or the potential design of garden roof systems which can drastically reduce stormwater runoff from buildings.

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<sup>22</sup> ASTM D 6245-98: Standard Guide for Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation. American Society for Testing and Materials. West Conshohocken, PA 19428.

## Section 7: References, Information sources, etc.<sup>23</sup>

The following lists provide some helpful resources that might be utilized to gather more information on sustainable design related topics. By no means is this list meant to be exhaustive, authoritative, nor in any way connote DCAM approval or endorsement.

### **Building Commissioning**

U. S. General Services Administration Model Commissioning Plan and Guide Specification at: <http://www.peci.org/cx/mcpgs.html>

The Building Commissioning Association at: <http://www.bcxa.org/>

ASHRAE Technical Committee (TC) 9.9 - Building Commissioning at: <http://www.ecw.org/tc99/>

### **Building Materials**

South Coast Air Quality Management District of California, Rules # 1113 (Architectural Coatings) & 1168 (Sealants and Adhesives) at: <http://www.aqmd.gov/rules/html/r1113.html> & <http://www.aqmd.gov/rules/html/r1168.html>

Certified Forest Products Council at: <http://www.certifiedwood.org/>

Commonwealth of Massachusetts' Operational Services Division's Environmentally Preferable Products (EPP) Procurement Program at: <http://www.mass.gov/osd/enviro>

US and Canadian Recycled Plastic Products Directory American Plastics Council, 2001. <http://recycledproducts.plasticsresource.com>

Recycled Product Suppliers Directory, Mass. Buy Recycled Alliance, DEP). May 2000.

Massachusetts Directory of Recycled Products Manufacturers. Chelsea Center for Recycling and Economic Development. Feb. 1999. Most updated information on [www.chelseacenter.org](http://www.chelseacenter.org).

California Integrated Waste Management Board. <http://www.ciwmb.ca.gov/GreenBuilding/>

City of Austin Texas Sustainable Building Sourcebook, list availability of specific EPP products <http://greenbuilder.com/sourcebook>

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<sup>23</sup> many references taken from the US Green Building Council at: <http://www.usgbc.org/resource/index.htm>

## **Energy Efficiency**

ASHRAE/IES 90.1-1989 - Energy Efficient Design of New Buildings Except New Low-Rise Residential Buildings at: <http://www.ashrae.org/>

U.S. Department of Energy's Energy Efficiency and Renewable Energy Network (EREN) Building Topics at: <http://www.eren.doe.gov/EE/buildings.html>

California Energy Commission's Energy Efficiency Standards for Residential and Nonresidential Buildings, (Title 24, Part 6) at: <http://www.energy.ca.gov/title24/index.html>

U.S. Environmental Protection Agency Energy Star Buildings Program at: <http://www.epa.gov/buildings/> Additional info available by calling: 800-STAR-YES

Energy Efficient Building Association at: <http://www.eeba.org/>

Buying Energy Efficient Products, US Department of Energy, FEMP. Call 1-800-363-3732.

## **Energy Modeling**

US Department of Energy's Office of Building Technology, State and Community Programs' Building Energy Software Tools at: [http://www.eren.doe.gov/buildings/tools\\_directory/](http://www.eren.doe.gov/buildings/tools_directory/) & [http://www.eren.doe.gov/buildings/tools\\_directory/database/page.cfm?Cat=EnergySim&Stat us=Yes&Menu=1&Sel=1&Desc=Energy+Simulation](http://www.eren.doe.gov/buildings/tools_directory/database/page.cfm?Cat=EnergySim&Stat us=Yes&Menu=1&Sel=1&Desc=Energy+Simulation)

US Department of Energy's Building Energy Modeling and Simulation - Self-Learning Modules at: [http://www.eren.doe.gov/buildings/tools\\_directory/software/bems-slm.htm](http://www.eren.doe.gov/buildings/tools_directory/software/bems-slm.htm)

## **Erosion Control**

US Environmental Protection Agency - Design of Stormwater, Sediment, and Erosion Control Systems at: <http://www.epa.gov/owow/watershed/wacademy/training/coll2.html>

## **General Sustainable Design & Green Building Principles/Programs/Information**

Architects, Designers, Planners for Social Responsibility at: <http://www.adpsr.org/NewPages/Directory.html>

Environmental Building News at: <http://www.buildinggreen.com/>

Environmental Design & Construction Magazine Online at: <http://www.edcmag.com/>

Green Builder Advisor software at: <http://www.greenbuildingadvisor.com/>

Rocky Mountain Institute's Green Development Service at: <http://www.rmi.org/sitepages/pid168.asp>

Pennsylvania's Green Building Initiative at:  
<http://www.gggc.state.pa.us/GreenBldg/greenhom.htm>

Sustainable Buildings Industry Council at: <http://www.sbicouncil.org/>

University of Virginia's Institute for Sustainable Design at: <http://www.virginia.edu/~sustain/>

US General Services Administration's real Property Sustainable Development Guide at:  
<http://policyworks.gov/org/main/mp/gsa/home.html>

US Department of Energy's Center of Excellence for Sustainable Development at:  
<http://www.sustainable.doe.gov/>

US Department of Energy's Office of Building Technology, State and Community Programs'  
Commercial High Performance Buildings project at:  
[http://www.eren.doe.gov/buildings/highperformance/chp/building\\_inventory.html](http://www.eren.doe.gov/buildings/highperformance/chp/building_inventory.html)

US Department of Energy (Pacific Northwest Laboratory) Office of Pollution Prevention -  
Pollution Prevention by Design homepage at: <http://www.pnl.gov/doesustainabledesign/>

## **Indoor Air Quality**

ASHRAE Standard 62-189 - Ventilation for Acceptable Indoor Air Quality (ANSI approved)  
at: <http://www.ashrae.org/>

Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Indoor Air  
Quality Guidelines for Occupied Buildings Under Construction at: <http://www.ashrae.org/> or  
contact SMACNA technical publications: 703-803-2980.

ASHRAE Standard 52.1-1992: Gravimetric and Dust-Spot Procedures for Testing Air-  
Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI  
approved) at <http://www.ashrae.org/>

US EPA Indoor Environments Division Indoor Air Quality (IAQ) Home Page at:  
<http://www.epa.gov/iaq/>

## **Solid Waste**

DEP's Recycling Program at: <http://www.state.ma.us/dep/recycle/business.htm#reg>

King County Washington State at:  
[http://dnr.metrokc.gov/swd/bizprog/sus\\_build/overview.htm](http://dnr.metrokc.gov/swd/bizprog/sus_build/overview.htm)



## **Thermal Comfort**

ASHRAE Standard 55-1992: Thermal Environmental Conditions for Human Occupancy (ANSI approved) at: <http://www.ashrae.org/>

## **Water Conservation**

Energy Policy Act of 1992 – Plumbing Fixture Requirements (42 USC Section 6295(i) at: <http://www4.law.cornell.edu/uscode/42/6295.html>

U. S. Environmental Protection Agency Water Efficiency Program at: <http://www.epa.gov/owm/genwave.htm>

## APPENDIX T

### CAMIS BUILDING AND EQUIPMENT FORM

Designer shall complete the CAMIS Building and Equipment Form for any new buildings and/or major equipment and systems (please see attached “Major Equipment and Systems” List) installed as part of the project. Such form shall be submitted as part of the project acceptance milestone (E-1).

**The Commonwealth of Massachusetts  
Executive Office for Administration and Finance  
Division of Capital Asset Management  
Office of Planning Design and Construction**

**Massachusetts State Project No. \_\_\_\_\_**

<b>Project Title</b>		
<b>Designer</b>		
<b>Contact Name</b>		
<b>Title</b>		
<b>Phone No.</b>	(       )	<b>Fax No.</b> (       )
<b>E-mail</b>		

#### **BUILDING INFORMATION: (if applicable)**

<b>Structure ID</b>		
<b>Executive Office</b>		
<b>Agency</b>		
<b>Facility Name</b>		
<b>Facility Address</b>		
<b>Contact Name</b>		
<b>Title</b>		
<b>Phone No.</b>	(       )	<b>Fax No.</b> (       )
<b>E-mail</b>		
<b>Building Name</b>		
<b>Building Address</b>		
<b>Building Type</b>	Please select from the attached “Building Type” List.	
<b>Building Usage</b>	Please select from the attached “Building Usage” List.	
<b>Construction Year</b>		
<b>Construction Cost</b>	\$	
<b>Square Footage</b>	<b>Gross:</b>	<b>Net:</b>
<b>Number of Floors</b>		
<b>Basement</b>	<b>Yes / No</b>	
<b>Historic Building</b>	<b>Yes / No</b>	
<b>USGS Coordinates</b>	<b>X:</b>	<b>Y:</b>
<b>Photo</b>	Submit digital photograph (in .jpg format) of the front of the building.	

## APPENDIX T

### EQUIPMENT INFORMATION: (copy this page for all equipment as needed)

<b>Equipment Name</b>	
<b>Equipment Description</b>	
<b>Category</b>	Please select from the attached "Category" List, e.g. MECH / HVAC / CHILLER.
<b>Manufacturer</b>	
<b>Manufacturer Part No.</b>	
<b>Model No.</b>	
<b>Serial No.</b>	
<b>Site</b>	
<b>Building</b>	
<b>Floor</b>	
<b>Room</b>	
<b>Installation Cost</b>	\$
<b>Year Installed</b>	
<b>Projected Useful Life</b>	
<b>Warranty:</b>	
<b>Reference No.</b>	
<b>Expiration Date/Usage</b>	
<b>Vendor</b>	
<b>Contact Name</b>	
<b>Phone No.</b>	(       )

---

**Designer**

---

**Date Submitted**

## APPENDIX T

### List of the Major Equipment and Systems for which data needs to be completed in the CAMIS Building and Equipment Form:

- Absorption Water Chiller
- Air Circuit Breaker
- Air Compressor
- Air Dryers
- Air Handler Unit
- All Other Pumps
- Automatic Transformer Switch
- Boiler
- Booster Pump
- Building Exhaust
- Burner
- Capacitor Bank
- Centrifugal Fan
- Centrifugal Water Chiller
- Chilled Water Pump
- Chiller
- Circulating Pump
- CO2 Detectors
- Condensate Pump
- Condenser
- Control Air Compressor
- Control Panel
- Cooling Tower
- Cooling Tower (Dry Cooler)
- Current Limiting Reactor
- Dampers
- Delta 2000 System (EMS)
- Detection System
- Diesel Fuel Tank
- Domestic Water Softener
- Dumbwaiter
- Electric Heater
- Electric Transfer Panel
- Electric Vault
- Elevator
- Elevator / Escalator
- Emergency Engine
- Emergency Generator Set
- Emergency Lighting
- Fire Alarm
- Fire Alarm Panel
- Fire Hydrants
- Fire Pump
- Freight Elevator
- Fuel Oil Storage Tank
- Furnace
- Gas Detection (alarm)
- Generator Assemblies
- Grinder
- Heat Exchanger
- Heat Recovery System
- Hot Water Boiler
- Hot Water Heater
- Hydro Gate
- Laboratory Air Compressor
- Louvers
- Main Back Flow Preventer
- Main Disconnect
- Main Secondary Disconnect
- Main Sprinkler Valve
- Main Transformer
- Man Hole
- Motor
- Panel Board
- Passenger Elevator
- Preheat Pump
- Pressure Reducing Station
- Pump
- Pump / Motor
- Pumpdown Assembly
- Radiation and Reheat Pumps
- Reciprocating Water Chiller
- Refrigeration Compressor
- Return Register
- Reverse Osmosis Filter
- Roof A/H Units
- Rotary Screw Chiller
- Sand Filter Equipment
- Security System Panel
- Sewage Pump
- Snowmelt Systems
- Steam Boiler
- Sump Pump
- Supply Air Register
- Swimming Pools
- Switchgear >5KV
- Tank
- Transfer Pump
- Treatment System
- Turbine Generator
- Unfired Steam Generator
- UPS, Uninterruptible Power Systems
- UV Disinfection Equipment System
- Vacuum Pump and System
- Walk-in Cooler
- Walk-in Refrigeration Units (Cold Storage)
- Water Heater / Exchanger
- Water Purification - Deionizer Water Piping
- Water Purification – Distilled Water Piping
- Well Pump

## APPENDIX T

### “Building Type” List:

- Concrete Frame with Infill Shear Walls
- Concrete Moment Frame
- Concrete Shear Walls
- Other Than Standard Construction Type
- Precast/Tilt-Up Concrete walls with lightweight Flexible Diaphragms
- Precast Concrete Frames with Concrete Shear Walls
- Reinforced Masonry Bearing Walls, Unknown Subtype
- Reinforced Masonry Bearing Walls with Precast Concrete Diaphragms
- Reinforced Masonry Bearing Walls with Wood/Metal Deck Diaphragms
- Steel Braced Frame
- Steel Light Frame
- Steel Moment Frame
- Steel Frame with Concrete Shear Walls
- Steel Frame with infill Masonry Shear Walls
- Unreinforced Masonry Bearing Wall Buildings
- Wood, Commercial & Industrial
- Wood, Light Frame

### “Building Usage” List:

- Administration
- Agricultural
- Animal Housing (not Barn)
- Armory
- Auditorium / Theater
- Auto Technology
- Band Stand
- Barn and/or Storage and/or Stables
- Barracks
- Bath House
- Bathroom
- Bleachers
- Boathouse
- Bridge House
- Bunker
- Business / Retail
- Cabin
- Campground / Picnic Area
- Camping Shelter
- Car Wash
- Carport
- Carriage House
- Cellar
- Changing Rooms
- Chapel
- Chicken Coop
- Civil Defense
- Classroom
- Classroom / College
- Classroom / Elementary
- Classroom / Offices
- Classrooms / Laboratory
- Clubhouse / Tickets
- College Student Center
- Comfort Station
- Commercial Services
- Concession Stand
- Conference Rooms
- Contact / Ranger / Park / Forest Station
- Corrections
- Corrections / Administration
- Corrections / Boot Camp
- Corrections / Cellblock
- Corrections / Detention Building
- Corrections / Job Training
- Courthouse
- Dam Operations Building
- Day Care Facility
- Detox Building
- Dining Hall
- Education
- Electrical Distribution
- Electrical Substation
- Engine / Generator house
- Fair Exposition Building
- Field House
- Field Trail Building
- Fire Barn
- Fire Station
- Fireplace
- Fish Hatchery
- Food Preparation and/or Dining

## APPENDIX T

### “Building Usage” List: (continued)

- Forestry Camp
- Fort
- Garage and/or Other
- Garage and/or Storage
- Gasoline Station Pump & Tank
- Gatehouse
- Gazebo
- Greenhouse
- Guard Tower
- Guardhouse
- Gymnasium
- Gymnasium and/or Pool
- Hazardous Waste Storage
- Heating Plant / Boiler Room
- Hospital
- Hospital / Clinic
- Hospital / Wards
- Ice House
- Incinerator
- Industrial
- Laboratory
- Laundry
- Library
- Light Manufacturing
- Liquid Storage (Tank)
- Loading Dock
- Machinery Shed
- Maint. / Grounds Care / Shed / Repair
- Maintenance
- Marina
- Marine & Water Transportation
- Medical / Offices
- Mental Health
- Metering Station
- Miscellaneous
- Monument
- Morgue
- Museum
- Natural Resource Residence
- Nature Center / Exhibition
- Night Registration Building
- Office
- Office Trailer
- Open Field
- Park Headquarters
- Parking
- Parking Garage
- Pavilion and/or Canopy
- Photovoltaic Building
- Piggery
- Police Station
- Pool
- Power Supply Facility
- Pressbox
- Pump House
- Pump House (H2O) Not Gasoline
- Quanset Hut / Hazmat Shed
- Rec. Building Dugout
- Recreation Building / Facility
- Recreational Court
- Recycling Center
- Redemption Center
- Reservoir Building Aqueduct
- Residence Day Program
- Residence with attached garage
- Residence / Dormitory
- Residence / House
- Residence / ICFMR-LGR
- Residence / Office
- Residence / Other
- Residence / Wards
- Residential
- Restaurant
- Salt Storage
- Salvage Yard
- Sand Shed
- Saw Mill
- School/High
- Septic Pumping
- Service Building
- Sewage Drainage
- Sewage Treatment Plant
- Sewer Maintenance
- Shed
- Silo / Feed House and Storage
- Skating Rink
- Ski Lodge / Large
- Slaughterhouse
- Social Events & Guesthouse
- Specialty Workshop
- Springhouse
- Storage
- Student Honors House
- Telecommunications
- Tower
- Training Center
- Tunnel System
- University Non-Residential
- Valve House for Water Tower
- Visitors Center/Information
- Warehouse
- Waste Water Pumping Station
- Water Supply
- Water Tower
- Wharves

## APPENDIX T

### “Category” List:

- CONV / CONVEYING / ELEV DWTR
- CONV / CONVEYING / ELEV FRGT
- CONV / CONVEYING / ELEV PASS
- CONV / CONVEYING / ELEVATOR
- CONV / CONVEYING / ELV / ESCL
- ELEC / BLDGSECUR / DETECTION
- ELEC / BLDGSECUR / FIRE ALARM
- ELEC / BLDGSECUR / SECURITY
- ELEC / DOMWATER / MOTOR
- ELEC / ELECDIST / AIRCIRBRKR
- ELEC / ELECDIST / CAP BANK
- ELEC / ELECDIST / DISCONNECT
- ELEC / ELECDIST / ELECTR TRF
- ELEC / ELECDIST / EMRG CY ENG
- ELEC / ELECDIST / GENERATOR
- ELEC / ELECDIST / MAINSECDIS
- ELEC / ELECDIST / MANHOLE
- ELEC / ELECDIST / PANEL BRD
- ELEC / ELECDIST / REACTOR
- ELEC / ELECDIST / SWITCHGEAR
- ELEC / ELECDIST / TRANSFORMR
- ELEC / ELECDIST / TRNSFMR SW
- ELEC / ELECDIST / TURBN GENR
- ELEC / ELECDIST / UPS SYSTEM
- ELEC / ELECDIST / VAULT
- ELEC / FIREPRODET / ALARM FIRE
- ELEC / FIREPRODET / ALARM GAS
- ELEC / FIREPRODET / EMRG CY GEN
- ELEC / FIREPRODET / FIRE ALARM
- ELEC / FIREPRODET / FIRE PUMP
- ELEC / LIGHTING / EMERGLGHT
- ELEC / SPECIALTY / DELTA 2000
- MECH / DOMWATER / BACK FLOW
- MECH / DOMWATER / BURNER
- MECH / DOMWATER / PUMPS
- MECH / DOMWATER / WP WTRSOFT
- MECH / DOMWATER / WTR\_HEATER
- MECH / DOMWATER / WTRHT\_EXCH
- MECH / FIREPRODET / BACK FLOW
- MECH / FIREPRODET / FIRE HYDRT
- MECH / FIREPRODET / PUMP FIRE
- MECH / FIREPRODET / SPRINKLER
- MECH / HVAC / AH UNIT
- MECH / HVAC / AIR CMPRSR
- MECH / HVAC / BACK FLOW
- MECH / HVAC / BLDG EXHST
- MECH / HVAC / BOILER HW
- MECH / HVAC / BOILER STM
- MECH / HVAC / BOILERS
- MECH / HVAC / CHIL ABSOR
- MECH / HVAC / CHIL CENT
- MECH / HVAC / CHIL RECIP
- MECH / HVAC / CHIL ROTAR
- MECH / HVAC / CHILLER
- MECH / HVAC / COMP AIR
- MECH / HVAC / CONDENSER
- MECH / HVAC / COOLG TOWR
- MECH / HVAC / CTRFUG FAN
- MECH / HVAC / CTWR DRYCL
- MECH / HVAC / DAMPERS
- MECH / HVAC / ELECTR HTR
- MECH / HVAC / FAN RETURN
- MECH / HVAC / FAN SUPPLY
- MECH / HVAC / FURNACE
- MECH / HVAC / HEAT EXCHG
- MECH / HVAC / HEAT RECOV
- MECH / HVAC / LOUVERS
- MECH / HVAC / PRV STATN
- MECH / HVAC / PUMP BOOST
- MECH / HVAC / PUMP CHWTR
- MECH / HVAC / PUMP CIRC
- MECH / HVAC / PUMP CONDS
- MECH / HVAC / PUMP OTHER
- MECH / HVAC / PUMP PHEAT
- MECH / HVAC / PUMP RADRH
- MECH / HVAC / PUMP VAC
- MECH / HVAC / PUMPDOWN
- MECH / HVAC / PUMPS
- MECH / HVAC / ROOF AH
- MECH / HVAC / STEAM GENR
- MECH / LAUNDARY / WTR\_HEATER
- MECH / MECH / PUMPS
- MECH / SANISEWER / PUMP SEWGE
- MECH / SANISEWER / PUMP SUMP
- MECH / SPECIALTY / AIR DRYERS
- MECH / SPECIALTY / COLD STRG
- MECH / SPECIALTY / CONDENSER
- MECH / SPECIALTY / COOLER
- MECH / SPECIALTY / COOLG TOWR
- MECH / SPECIALTY / PUMP TRANS
- MECH / SPECIALTY / PUMP WELL
- MECH / SPECIALTY / PUMP/MOTOR
- MECH / SPECIALTY / PUMPS
- MECH / SPECIALTY / SNWMLT SYS
- MECH / SPECIALTY / TANKS
- MECH / SPECIALTY / TREAT SYS
- MECH / SPECIALTY / WP DEIONZR
- MECH / SPECIALTY / WP DISTILL
- MECH / SPECIALTY / WPREVOSMS
- SPEC / COLD STRG / COMP REFRG
- SPEC / ELECDIST / FUEL TANK
- SPEC / HVAC / COMP CNTRL
- SPEC / HVAC / COMP LAB
- SPEC / HVAC / STORG TANK
- SPEC / SANISEWER / CONTROLPNL
- SPEC / SANISEWER / GENSET
- SPEC / SANISEWER / GRINDER
- SPEC / SANISEWER / SAND FILTR
- SPEC / SANISEWER / UV DISINFCT
- SPEC / SPECIALTY / DETECTCO2
- SPEC / SPECIALTY / HYDRO GATE
- SPEC / SPECIALTY / POOL EQUIP

## Form 9 Update

### December 1, 2000

1. List of Revisions from former Form 9 (*new*)
2. Revision February 23,2000 (*update*)  
(*Item 6 Maintenance Report added*)
3. Section 01650, Commissioning Requirements (*new*)  
(*Insert after Section 01600*)
4. Appendix N, Sustainable Design (*update*)  
(*Replace the existing Appendix N*)
5. Appendix M, Construction Sign (*update*)  
(*Replace the existing Appendix M*)
6. Appendix R, Guidelines For Designer's Work Plan (*new*)
7. Appendix S, Designer Evaluation Forms and Instructions (*new*)
8. Miscellaneous Revisions (*new*)



## Changes to Form 9 Instructions to Designers

The following items are changes to Form 9. This list is not complete, but attempts to highlight the major changes and additions:

- Definitions, this list of definitions has been added to clarify some of the terminology used in Form 9
- General
- Administrative Requirements
  - Item (f) DCAM's right to reject submissions without complete review
  - Item (h) product notebook is required
  - Item (I) Code analysis sheet is required
- Design Requirements
  - Item (f) Life cycle cost analysis clarified
  - Item (g) Alternate design schemes clarified
  - Item (h) Designer shall not contact local agencies without prior approval (*caution added*)
  - Item (j) Utility rebate investigation required
- Drawing Requirements
  - Item (l) submission in electronic format required
- Specification Requirements
  - Item (e) submission in electronic format required
- Surveys, subsoil Explorations and Testing
  - General revisions
  - Item (d) Testing
  - Item (e) Testing of Potentially Contaminated Materials added
- Life Cycle Costing clarified
- Testing of Suspected Asbestos Containing Material added
- Schematic Phase
  - General
    - Item b) Alternate design submissions clarified
    - Item g) list of permits and testing required
- Design Development Phase
  - Drawing Requirements
    - Item a) (1) (f) Site Profile added
    - Item a) (2) Existing Conditions and Demolition Drawings required
  - Product Requirements, product note books are required from the Designer
- Construction Document Phase
  - Drawing Requirements
    - Item j) Quality Control Drawings, required from the Designer to ensure a method of Quality Control added
  - Maintenance Report, annual maintenance cost of buildings over 5 million dollars added
- Specification Format, updated to the newest CSI

December 1, 2000

- Construction Progress Schedule, new section refer to Appendix P
- Construction Facilities and Temporary controls
  - Project Identification, sign changes
  - Field Offices, computer revisions/schedule requirements
- Contract closeout
  - Operating and Maintenance Requirements revised
    - A.2. Electronic Format added
- DCAM Requirements and Standards, many small changes
- Appendices
  - Appendix A, Schedule of Procedures (*updated*)
  - Appendix B, Meeting Minute Format (*new*)
  - Appendix C, Code and Regulatory Check List (*new*)
  - Appendix H, Unit Price Sheet - General Contractor's Work (*updated*)
  - Appendix Ha, Unit Price Sheet – Sub-Contractor's Work (*updated*)
  - Appendix M, Sample Construction Sign (*revised*)
  - Appendix N, Sustainable Design Elements (*new*)
  - Appendix O, Environmental Issues (*new*)
  - Appendix P, Sample List of Asbestos Containing Material (*new*)
  - Appendix Q, Construction Progress Schedules (*new*)
  - Appendix R, Guidelines For Designer's Work Plan (*new*)
  - Appendix S, Designer Evaluation Forms and Instructions (*new*)

of performance bond and labor and materials or payment bond shall be submitted in writing to DCAM with a copy to the Designer.

- (2) The Designer shall immediately draft a response to DCAM relative to all questions and shall include its recommendations for possible inclusion in an addendum.
  - (3) The Designer shall compute, establish and itemize the added cost or deduction to the estimated contract price for all items to be included in the addendum.
  - (4) The necessity and cost of the proposed addendum shall be written in a separate letter provided that DCAM has been verbally informed as to the necessity and cost.
  - (5) The addendum shall be clearly typed on good quality unfolded bond paper and delivered to DCAM at least seven working days prior to the receipt of sub-bids or if no sub-bids are involved, seven working days prior to the receipt of general bids.
  - (6) Addendum pages, including any drawings, shall be numbered consecutively with total attachments indicated on each page, i.e. page 1 of 8. page 2 of 8, -- page 8 of 8.
  - (7) **(Refer to Appendix J)** for sample addendum format.
- c) The Designer shall attend sub-bid openings.
  - d) The Designer shall review and evaluate sub-bids.
  - a) The Designer shall attend General Contractor bid opening.
  - b) The Designer shall review and evaluate general bids.
  - c) The Designer shall review qualifications of the lowest responsible, eligible general Bidder and submit it's reviews in writing to DCAM.

## **6. Maintenance Report**

- a) *The Designer shall prepare an analysis detailing the maintenance cost projected annually over the useful life of the building, if the projected building cost is in excess of five million dollars.*

*[Note to Designer: Consider including this section on larger projects or projects which contains new equipment]*

## SECTION 01650

### COMMISSIONING REQUIREMENTS

#### PART 1 GENERAL

##### 1.01 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS, which are hereby made a part of this Section of the Specifications.

##### 1.02 OVERVIEW

- A. Commissioning. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the owner's operational needs. This is achieved through actual verification of systems performance during the construction period.

Commissioning during construction is intended to achieve the following specific objectives in accordance with the Contract Documents:

- 1) Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards that they receive adequate operational checkout by installing contractors.
  - 2) Verify and document proper performance of equipment and systems.
  - 3) Verify that O&M documentation provided is complete.
  - 4) Verify the University of Massachusetts Boston operating personnel are adequately trained.
- B. The commissioning process does not take away from or reduce the responsibility of the General Contractor and installing subcontractors to provide a finished and fully functioning product.
- C. Abbreviations. The following are common abbreviations used in the Specifications.

A/E - Designer including Consultants  
CA - Commissioning authority (DCAM and UMB representatives)  
CC - HVAC Controls sub-subcontractor  
Cx - Commissioning  
Cx Plan - Commissioning Plan document  
EC - Electrical subcontractor  
FT - Functional performance test  
GC - General Contractor  
MC - Mechanical subcontractor  
PM - Project Manager (DCAM)  
TAB - Test and Balance subcontractor  
TE - Test Engineer (Hired by the General Contractor)

- D. Commissioning Team. The members of the Commissioning Team consist of the Commissioning authority (CA), the General Contractor (GC or Contractor), the architect and design engineers (particularly the mechanical engineer), the Mechanical Subcontractor (MC), the Electrical Subcontractor (EC), the TAB representative, the HVAC Controls Sub-Subcontractor (CC), any other installing subcontractors or suppliers of equipment.

### 1.03 SCOPE OF WORK

- A. The intent of this section is to require the General Contractor to provide qualified testing expertise to organize, schedule, coordinate and perform functional performance testing as outlined in Division 15 and 16.
- B. The General Contractor shall provide the services of a Test Engineer qualified in planning and performing testing, and troubleshooting equipment and systems, as described in these specifications.
- C. Commissioned Systems

The following systems and equipment will be commissioned in this project. All general references to equipment in this document refer only to equipment that is to be commissioned.

1. HVAC System (and all integral equipment controls) *[Note to Designer: This list of equipment should be unique to each project]*
  - Pumps
  - Variable speed drives
  - Piping, cleaning and flushing
  - Ductwork and dampers
  - Air handling units
  - DX units
  - Split systems
  - Fin tube radiation
  - Fan coil units
  - CO Detection
  - Terminal units
  - Testing, Adjusting and Balancing work
  - Unit heaters
  - Methane Gas Venting Sensors and Blowers
  - Atrium Exhaust and Stair Pressurization system
  - Fuel Oil System
  - Building automation system (controlled devices, control loops and system integration)
  - Kitchen exhaust systems
  - Boilers
  - Chillers

2. Electrical Systems  
Central lighting control system (interior and exterior)  
Electrical system power quality  
Security system  
Emergency power systems
3. Plumbing  
Heat exchangers  
DHW Heaters

1.04 RELATED WORK

- A. Divisions 15 and 16 sections requiring functional performance testing.

1.05 RESPONSIBILITIES

- A. The Test Engineer shall:
  1. Review and approve all functional performance tests, results, and documentation required by the contract documents, for all equipment and systems, as performed by subcontractors, vendors, etc.
  2. Develop schedules for all testing, integrate testing into the master construction activity schedule and fully coordinate all subcontractor's testing as required.
  3. Develop test procedures and forms for documentation of all equipment tests, system functional tests, and cross system functional tests that are not already provided in Sections 15995 and 16995 and for heat exchangers under Section 15400. Test procedures shall be in accordance with equipment manufacturer's recommendations, where applicable. Test procedures shall fully describe system configuration and steps required for each test; appropriately documented so that another party can repeat the tests with virtually identical results.
  4. Submit test procedure schedule, procedures, forms, and other documentation to the DCAM Project Manager (PM) for approval, six months prior to starting any testing required by Division 15 and 16.
  5. Coordinate directly with each subcontractor on the project specific to their responsibilities and contractual obligations.
  6. Provide qualified personnel for participation in commissioning tests, including seasonal testing required after the initial commissioning.
  7. Provide engineering and technical expertise to oversee and direct the correction of deficiencies found during the commissioning process.

8. Observe the start-up and initial testing of equipment by the Contractor and subcontractors; and then all final tests of equipment and systems.
9. Manage all cross system testing such as HVAC, building automation, fire alarm, emergency power, life safety, elevators, etc.
10. Note any inconsistencies or deficiencies in system operations and enforce system compliance or recommend to the Designer modifications to system design, which will enhance system performance.
11. Coordinate through the PM the required Commissioning Authority and Designer testing participation and approval procedures, after verifying that pretests have been satisfactorily conducted and final tests are ready to be performed.
12. In the event that a functional test fails, the cause of failure shall be determined and rectified as soon as possible, and then re-tested. If more than three functional tests of the same system(s) are required, the Contractor shall reimburse DCAM all associated costs for the extraordinary participation of the Designer's staff, as required by the particular test being performed.
13. Review operation and maintenance information and as-built drawings provided organization, and by the various subcontractors and vendors for verification distribution.
14. Obtain all documentation from tests and assemble a final submitted to the Designer and the PM for approval.
15. Oversee and/or provide training for the systems specified in coordination by the Divisions 15 and 16 subcontractors.
16. All additional duties described in Sections 15995 and 16995.

#### 1.4 TEST ENGINEER QUALIFICATIONS

- A. The Test Engineer shall satisfy the following requirements :
  1. Have extensive experience in startup and troubleshooting HVAC, hot water heating, chilled water, plumbing, electrical, emergency power, fire alarm, life safety systems of similar complexity to those contained in these documents.
  2. Have excellent working knowledge of complex environmental, fire alarm, and electric power control and facility management systems; be capable of understanding control vendors' operating system and control codes, be capable of trouble-shooting control codes and recommending necessary modifications.
  3. Be competent in system design and intent.

4. Be knowledgeable in test and balance of both air and hydronic systems;
  5. Have excellent communication and writing skills, be highly organized, and be able to work well with both management and trades contractors.
- B. A Bachelors degree in Mechanical Engineering and P.E. certification, with extensive practical field experience, is preferred; however, other technical training and experience with extensive practical field experience will be considered.
- C. The Contractor shall submit the Test Engineer (TE) resume and document examples to the Designer and the PM for approval, which shall include the following:
1. Education and technical training
  2. Relevant work experience:
    - a. Project/Employer names/dates
    - b. Positions held
  3. Examples of prior building commissioning projects performed by the proposed TE:
    - a. List of projects similar in commissioning scope and complexity, including dates of project completion.
- D. The Test Engineer cannot be financially associated with any of the Division 1 through 16 subcontractors or vendors prior to engaging in this contract, to avoid potential conflicts of interest.
- E. The Commissioning Authority, through the PM, reserves the right to personally interview the Test Engineer candidate or request additional information, prior to placement in the position. Final approval of the Test Engineer will be by the PM.

PART 2- NOT REQUIRED.

PART 3- NOT REQUIRED.

END OF SECTION

COMMISSIONING REQUIREMENTS  
01650-5

December 1, 2000



## **APPENDIX N**

### **Sustainable Design**

Sustainable design is a holistic approach to construction which aims to use material, energy and water resources efficiently, minimize adverse site impacts, address the health issues relating to construction and indoor environments, and support the use of local resources. Major elements of sustainable design are efficiency in the use of energy, water and other resources.

Sustainable design can be achieved by undertaking collaborative and conscious design and product selection choices without lowering construction quality or aesthetics, increasing costs, or making program sacrifices. Sustainably designed buildings are high performance buildings that meet the fiscal and mission-critical responsibilities of the Commonwealth's agencies.

Keeping up with industry standards is an important goal of the Division of Capital Asset Management, and sustainable design is fast becoming an industry standard to improve design quality. Sustainable design techniques and technologies aim to improve the overall performance and aesthetics of the buildings owned and occupied by the Commonwealth and its citizens, workers, students, and residents. In addition, sustainable design has the potential to have far-reaching impacts related to the local, regional, national and global environment, including slowing global climate change, improving air quality, reducing ozone depletion, and protecting natural resources, among others.

By formalizing sustainable design requirements, Massachusetts affirms its commitment to designing and building high performance buildings. As this field evolves and new technologies, techniques and standards are developed and proven, DCAM plans to update the information included herein. Furthermore, DCAM encourages designers to take the initiative to propose alternative sustainable design opportunities for potential use in DCAM projects. Through these actions, Massachusetts' public buildings can become a model for practical, achievable, high performance buildings and sustainable design.

In order to meet DCAM's sustainable design requirements, designers should concern themselves with the topics outlined in this appendix. They include the following:

- Section 1: Requirements by Division
- Section 2: Process for maximizing utility rebates for conservation measures
- Section 3: Compliance Energy Conservation requirements of Mass. State Building Code
- Section 4: Indoor Environmental Quality/Indoor Air Quality (IAQ) Considerations
- Section 5: Description of Life Cycle Cost Analysis (LCCA)
- Section 6: Other Sustainable Design Considerations
- Section 7: References, Information sources, etc.

## Section 1: Requirements by Division

The following specifications should be adopted by the designer as a standard consideration in all design processes. Where any of the below-recommended specifications cannot be met, the designer shall justify the need for exception to such specific design elements. Alternate designs shall be accepted if justified for economic or specific applicability reasons, such as availability or specific concerns unique to the project. Designers shall ensure that specifications can be met by at least three manufacturers. Designers shall specify only those products that meet the VOC standards established in the table published in Section 4 of this Appendix.

<b>Division 2: Site Work</b>	
02810 Irrigation Systems	<ul style="list-style-type: none"><li>• Equip irrigation systems with rain sensor overrides.</li><li>• Avoid line pressure misting sprinklers where possible.</li><li>• Consider submetering irrigation.</li><li>• Consider capturing rainwater or greywater for irrigation.</li></ul>
02900 Landscape work	<ul style="list-style-type: none"><li>• Use plants native to the site in order to reduce the need for soil amendments and excessive water.</li><li>• Minimize use of annuals or lawns.</li><li>• Consider use of natural plants and landscaped marshes to handle stormwater runoff from paved surfaces.</li></ul>
<b>Division 3: Concrete</b>	
03300 and 03400 Cast-In-Place Concrete And Precast Concrete	<ul style="list-style-type: none"><li>• Where removable formwork is used, specify a biodegradable form release agent.</li><li>• Consider specifying concrete, which contains fly ash content.</li></ul>
<b>Division 5: Metals</b>	
05050 Steel and aluminum	<ul style="list-style-type: none"><li>• Specify steel and aluminum with recycled content of 30% or greater or justifies the alternative.</li></ul>
<b>Division 6: Wood &amp; Plastic</b>	
06050 Treated wood	<ul style="list-style-type: none"><li>• Do not specify wood treated with copper chromium arsenate.</li></ul>
06600 Fences, decks, and benches	<ul style="list-style-type: none"><li>• Specify recycled plastic with a minimum of 50% recycled content or wood-recycled plastic composite products or justify the alternatives.</li></ul>
06100 Rough carpentry	<ul style="list-style-type: none"><li>• Specify composite boards without urea-formaldehyde binding resins.</li><li>• Specify structural fiberboard with a minimum of 85% post-consumer waste material or justify alternative.</li></ul>

06400 Architectural woodwork	<ul style="list-style-type: none"> <li>Consider using wood and wood products certified as coming from forests that meet internationally recognized principles of forest stewardship as promoted by the Forest Stewardship Council, such as "SmartWood."</li> <li>Specify water-based adhesives and low-VOC adhesives wherever possible.</li> </ul>
06600 Structural Plastics	<ul style="list-style-type: none"> <li>Consider using recycled plastic lumber for exterior decking, fencing, parking appurtenances, and outdoor site furnishings.</li> </ul>
<b>Division 7 - Thermal and Moisture Protection</b>	
07200 Building Insulation	<ul style="list-style-type: none"> <li>Specify insulation materials made without ozone depleting compounds.</li> <li>Specify insulation with at least 20% recycled material by weight.</li> </ul>
07900 Joint Sealants	<ul style="list-style-type: none"> <li>Specify that sealants that are not formulated with aromatic solvents, halogenated solvents, fibrous talc or asbestos, formaldehyde, mercury, lead, cadmium, hexavalent chromium, or their compounds.</li> </ul>
<b>Division 8 - Doors and Windows</b>	
08200 Wood Doors	<ul style="list-style-type: none"> <li>Specify wood doors with core materials that do not contain particleboard made with urea-formaldehyde binders.</li> <li>Consider wood doors certified as coming from forests that meet internationally recognized principles of forest stewardship as promoted by the Forest Stewardship Council, such as "SmartWood."</li> </ul>
08800 Glass and Glazing	<ul style="list-style-type: none"> <li>Use low-e glazings wherever practicable, especially on unshaded South facing aspects.</li> <li>Specify sufficient shading coefficient to prevent unnecessary heat gain.</li> </ul>
<b>Division 9 - Finishes</b>	
09200 Lath and Plaster	<ul style="list-style-type: none"> <li>Specify plaster with no-VOC-emitting additives, such as epoxy or other resins.</li> </ul>
09250 Gypsum Drywall Construction	<ul style="list-style-type: none"> <li>Specify drywall with facing paper from 100%-recycled content, if available or justify the alternative.</li> <li>When sound attenuation insulation is used in gypsum construction, specify that it be completely encapsulated within partitions and does not occur where particulate matter can enter return air plenums or other recirculation channels.</li> <li>Specify the installation of gypsum board with screws rather than laminating with adhesives.</li> <li>Specify paper joint tape rather than fiberglass tape. Specify low-VOC joint compound.</li> </ul>

09510 Acoustic Panel Ceiling	<ul style="list-style-type: none"> <li>Specify acoustic panel with a maximum recycled content or justify alternatives.</li> <li>Specify ceiling tile products that are free from formaldehyde. Do not specify vinyl-faced ceiling tiles.</li> </ul>
09640 Wood Flooring	<ul style="list-style-type: none"> <li>Consider wood certified as coming from forests that meet internationally recognized principles of forest stewardship as promoted by the Forest Stewardship Council, such as "SmartWood." OR consider "Rediscovered" wood products which may include that from: <ul style="list-style-type: none"> <li>demolition projects for antiquated buildings</li> <li>dead, fallen, diseased or nuisance trees</li> <li>orchards where unproductive trees are cut for replacement</li> <li>fallen trees carefully reclaimed from rivers and lakes</li> <li>usable wood safely reclaimed from demolition landfills</li> <li>wood by-products from secondary manufacturers</li> </ul> </li> </ul>
09650 Resilient Flooring	<ul style="list-style-type: none"> <li>Consider low-emission resilient flooring such as cork. Consider flooring made from recycled materials such as rubber (90% post consumer material), or plastic.</li> </ul>
09680 Carpet	<ul style="list-style-type: none"> <li>If possible, specify that carpeting products be approved by the Carpet and Rug Institute IAQ Testing Program and carry the approved logo.</li> <li>Avoid carpets with backing made from vinyl or styrene butadiene latex which is a primary emitter of 4-phenylcyclohexene (4-PC).</li> <li>Specify carpet with recycled backing.</li> <li>Specify Entry Carpet Matting with recycled rubber.</li> <li>Specify Food Service Matting with recycled rubber</li> <li>Keep carpet away from entranceways to avoid moisture and dirt build-up.</li> </ul>
09720 Wall Coverings	<ul style="list-style-type: none"> <li>Avoid the use of vinyl wall coverings.</li> <li>Consider the use of natural wall coverings such as sisal, jute, or cork.</li> </ul>
09840 Acoustical Wall Panels	<ul style="list-style-type: none"> <li>Avoid vinyl-faced acoustical wall panels.</li> <li>Specify wall panels that are manufactured without formaldehyde.</li> <li>Consider wall panels with high-recycled content.</li> <li>Specify installation methods that do not use adhesives.</li> </ul>

09910 Paint	<ul style="list-style-type: none"> <li>For general interior and exterior applications, use water-based, zero- or low-VOC latex paints and primers of VOC content not to exceed that identified in Table D of Section 4, below.</li> <li>Specify that water-based paints must not be formulated with aromatic hydrocarbons, formaldehyde, halogenated solvents, mercury or mercury compounds, or tinted with pigments of lead, cadmium, chromium VI, antimony and their oxides.</li> <li>Specify that paints shall be formulated without methylene chloride, toluene, ethyl benzene, vinyl Chloride, naphthalene, 1,2-dichlorobenzene, phthalates, isophoron, 1,1,1-trichloroethane, methyl ethyl ketone, methyl isobutyl ketone, acrolein, acrylo-nitrile and ethylene glycol, all of which pose threats to human health.</li> <li>Where solvent-based paints, high performance acrylic coatings, pigmented acrylic sealers, or epoxy coatings are necessary, specify VOC levels which meet the standards identified in Section 4, Table A, below.</li> </ul>
09930 Stains and Varnishes	<ul style="list-style-type: none"> <li>Use water-based stains and transparent finishes. Consider using natural stains and varnishes which are made without the use of petrochemical products.</li> <li>Specify products which meet the VOC standards established in Section 4, Table A, below.</li> </ul>
09980 Coatings for Concrete	<ul style="list-style-type: none"> <li>Specify water-based penetrating concrete meets the VOC standards established in Section 4, Table A, below.</li> </ul>
<b>Division 10 - Specialties</b>	
10160 Toilet Compartments	<ul style="list-style-type: none"> <li>Specify solid plastic toilet compartments fabricated from recycled high-density polyethylene (HDPE).</li> </ul>
<b>Division 11 - Equipment</b>	
11450 Appliances	<ul style="list-style-type: none"> <li>Specify energy efficient and water saving appliances. Check with local utility for rebates available for high efficiency equipment, and specify products that meet such criteria where they exist.</li> <li>Specify "Energy Star" approved appliances.</li> </ul>
<b>Division 12 Furnishings</b>	
12800 Planters	<ul style="list-style-type: none"> <li>Specify plastic planters fabricated from recycled high-density polyethylene (HDPE).</li> </ul>

<b>Division 13 - Special Construction</b>	
13175 Ice Skating Rinks	<ul style="list-style-type: none"> <li>• Ice Skating Rinks shall be designed with maximum energy efficiency including but not limited to: <ul style="list-style-type: none"> <li>• low-e ceilings</li> <li>• premium efficient motors</li> <li>• heat exchangers</li> <li>• energy management and control systems</li> <li>• liquid pressure amplifier</li> </ul> </li> </ul>
13165/13170 Pools	<ul style="list-style-type: none"> <li>• Designers of pools at educational facilities must comply with MGL Ch. 164, § 331 (as amended) that requires the Division of Capital Asset Management to evaluate the use of solar or other renewable energy systems as the primary energy source for hot water.</li> <li>• Pool design should consider a pool cover system.</li> </ul>
Educational facilities (domestic water heating)	<ul style="list-style-type: none"> <li>• Designers of educational facilities with a demand for hot water in excess of 1000 gallons per day must comply with MGL Ch. 164, § 331 (as amended) that requires the Division of Capital Asset Management to evaluate the use of solar or other renewable energy systems as the primary energy source for hot water.</li> </ul>
Laboratories	<ul style="list-style-type: none"> <li>• Evaluate fume hood controls and associated variable air volume systems for laboratories.</li> </ul>
<b>Division 14 - Conveying Systems</b>	
14200 Elevators	<ul style="list-style-type: none"> <li>• Consider using high-speed elevators with AC variable frequency drives.</li> <li>• Evaluate the use of closed dampers in elevator shafts to prevent heat loss.</li> <li>• Evaluate elevator shafts as sources of radon.</li> </ul>
<b>Division 15 - Mechanical</b>	
15400 Plumbing	<ul style="list-style-type: none"> <li>• Public toilet room sink fixtures shall not exceed 0.5 GPM at 80 PSI.</li> <li>• Showerhead fixtures shall be of low flow type, maximum 2.5 GPM @ 80 PSI.</li> <li>• All new toilets shall be a maximum 1.6 GPF. Existing toilets should be retrofit with Sloan Valve Retrofit Kits or similar wherever possible.</li> <li>• Consider infrared sensors for automated faucet control.</li> <li>• Consider the use of waterless urinals and composting toilet systems whenever possible.</li> </ul>

15050/15900 HVAC	<ul style="list-style-type: none"> <li>• Evaluate HVAC system(s) with life cycle cost analysis and specify least cost products when considering capital and operating costs (factor-in any available utility rebates).</li> <li>• Specify high efficiency heating and cooling equipment, including all boilers, chillers, pumps, motors, and related items.</li> <li>• Specify variable frequency drives whenever possible.</li> <li>• Install heat exchanger systems whenever possible.</li> <li>• Consider air to air or desiccant heat exchangers.</li> <li>• Consider the Federal Energy Management Program standards for Air Conditioners as a minimum.</li> <li>• Consider direct digital control energy management and control systems (DDC/EMCS).</li> <li>• Consider alternatives to the use of HCFCs as refrigerants.</li> <li>• Specify energy &amp; water efficient cooling towers (with delimiters to reduce drift and evaporation).</li> <li>• Consider specifying that HVAC ductwork be delivered to the site with caps and that these caps are replaced each night to prevent contamination during construction.</li> <li>• Consider inclusion of occupancy sensors and/or CO<sub>2</sub> sensors in rooms with intermittent or highly variable occupancy levels.</li> <li>• Consider underfloor displacement ventilation system as alternative to hung ceilings and overhead ductwork.</li> </ul>
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<b>Division 16 - Electrical</b>	
16500 Lighting	<ul style="list-style-type: none"> <li>• Evaluate lighting design with life cycle cost analysis and specify least cost products when considering capital and operating costs (factor-in any available utility rebates).</li> </ul> <p><u>Interior lighting</u></p> <ul style="list-style-type: none"> <li>• Specify fluorescent rather than incandescent lighting.</li> <li>• Specify combinations for T-5s, T-8s, compact fluorescents, and electronic dimmable ballasts (with system-integrated photosensors for perimeter/windowed areas).</li> <li>• Maximize the integration of daylighting through the use of vertical fenestration, light shelves, clerestories, photosensors, and transparent interior partitions, as well as good window design.</li> <li>• Use occupancy sensors and multi-switching wherever possible.</li> <li>• Target lighting power density in offices should be 1 Watt/square foot or less.</li> <li>• When HID lights are needed, use consider 2 stage switching.</li> <li>• Consider impact of lighting (and other internal building loads) on HVAC system design.</li> </ul> <p><u>Exterior lighting</u></p> <ul style="list-style-type: none"> <li>• Specify metal halide or high pressure sodium lamps for general purpose exterior lighting.</li> <li>• Consider solar-powered exterior lighting (especially for remote areas, large parking lots, etc.).</li> <li>• Equip exterior lighting with photosensors.</li> <li>• Minimize light overlap.</li> </ul> <p><u>Emergency lighting</u></p> <ul style="list-style-type: none"> <li>• Specify LED (Light-emitting diode) exit signs.</li> </ul>
1400, 1500 & 1600 Motors	<ul style="list-style-type: none"> <li>• Evaluate motors and drives based on life cycle cost analysis and specify premium efficient motors and variable speed drives (VSDs) wherever possible. Seek utility rebates for high- premium efficient motors and drives wherever possible.</li> </ul>



## Section 2: Process for maximizing utility rebates for conservation measures

Most electric and gas utility companies offer energy management programs (a.k.a., demand side management, DSM) programs to help customers design and install energy efficient equipment. These programs offer rebates to customers as incentives to increase efficiency over what would be considered “standard” efficiency. Each utility offers a different set of programs and they are continually changing as the energy markets continue to evolve with various phases of de- and re-regulation. Designers should consult with the jurisdictional utilities (electric and gas) for information on the specific rebates available for the products specified in the various design schemes put-forth.

In general projects can receive rebates for the following types of efficiency measures in renovations and new construction:

### Electric

Efficient lighting  
Efficient heating (not likely)  
Efficient air conditioning  
Efficient cooling towers  
Ground source heat pumps  
Window glazing to reduce cooling load  
Premium efficiency motors  
Variable speed drives  
Variable air volume systems  
Fume hood controls  
Energy Management and Control Systems (EMCS)

### Gas

Switching to gas from another fuel  
Efficient space heating  
Efficient air conditioning  
Efficient water heating  
Innovative technology demonstration  
Building envelop & design modeling  
Development in economic development zones

In addition, the utilities often can offer design assistance to help design efficient systems. (This usually applies to larger projects.)

The design team shall help DCAM participate in the utility rebate programs. The designer will make the first contact with the utility and determine accurate rebate amounts. DCAM Energy Team staff will be available for further contact with utilities and facilitation of rebates, including transmittal of commitment letters and distribution of funds to contractors.

To ensure that eligible rebates are collected, DCAM Energy Team will work with the designer to help to determine if utility rebates apply and determine the schedule for design to meet prescriptive rebate requirements and/or to participate in custom design programs.

### Section 3: Compliance with Energy Conservation requirements of Massachusetts State Building Code

The designer is responsible for documenting that all aspects of the project design meet or exceed the Energy Conservation requirements of the Massachusetts State Building Code (780 CMR, Chapter 13). The new Code requires energy conservation requirements for new commercial buildings in Massachusetts. The new requirements will take full effect on January 1, 2001.

The new Code requirements update the stringency of the Code to reflect improvements in technology, design, and construction of energy systems. The new Code is also significantly easier to use than the old one, with a clearer structure, simplified tables, and new software to demonstrate design compliance. These changes include elements from both the revised ASHRAE Standard 90.1 and from the International Energy Conservation Code (IECC), as well as some requirements that are unique to Massachusetts. All DCAM projects shall meet the new Code requirements.

## Section 4: Indoor Environmental Quality/Indoor Air Quality (IAQ) Considerations

The designer shall take all possible steps to ensure that the building's indoor environment (including, but not limited to air quality) is safe and healthy. Mechanical designers should exercise deliberate care to ensure that achieving thermal comfort and desired relative humidity control be done in a fashion which ensures that adequate ventilation and distribution of air is achieved and that airborne contaminants and potential toxins are not introduced. There are many strategies for achieving these goals including adherence to the relevant regulations and standards regarding air changes and system operation.

Among the strategies to ensure good indoor air quality are evaluation and isolation of potential sources of contamination, careful humidity control, avoidance of exposure to airborne pollutants (such as from VOC offgassing, cleaning solvents and pest control), and the utilization of carbon dioxide monitors to ensure good IAQ in occupied spaces.

To help avoid contamination of the indoor environment from architectural products, the designer should specify architectural products that contain low levels of volatile organic compounds (VOCs). Additionally, VOC emissions rates of designated materials should be obtained from information available from the manufacturer and from Material Safety Data Sheets (MSDS). Designers will be expected to submit MSDS for those specified products for which they exist.

The following tables provide information for the maximum VOC content for architectural coatings, adhesives and sealants. Materials specified by designers shall not exceed these limits for any products to be utilized in DCAM projects. These rates have been scientifically determined and approved as standards by the South Coast Air Quality Management District of California,<sup>1</sup> Greenseal<sup>2</sup>, and the Carpet and Rug Institute<sup>3</sup> to protect human health and the environment; they have also been accepted as baseline standards by the US Green Building Council.<sup>4</sup>

**Table A: ARCHITECTURAL COATINGS<sup>5</sup>**

<b><u>COATING</u></b>	<b><u>Limit VOC, Grams Per Liter (Less Water and Less Exempt Compounds)</u></b>
Bond Breakers	350
Chemical Storage Tank Coatings	420
Clear Wood Finishes:	
Varnish	350
Clear Wood Finishes (cont.):	
Sanding Sealers	350
Lacquer	550
Concrete-Curing Compounds	350
Dry-Fog Coatings	400
Essential Public Service Coating	420
Fire-proofing Exterior Coatings	350
Fire-Retardant Coatings:	
Clear	650
Pigmented	350

<sup>1</sup> For more information, see South Coast Air Management District (SCAQMD) at: <http://www.aqmd.gov>

<sup>2</sup> For more information, see Greenseal at: <http://www.greenseal.org/standard/paints.htm>

<sup>3</sup> For more information, see the Carpet & Rug Institute at: <http://www.carpet-rug.com/>

<sup>4</sup> For more information, see The US Green Building Council at: <http://www.usgbc.org/>

<sup>5</sup> For more information, see SCAQMD Rule 1113: <http://www.aqmd.gov/rules/html/r1113.html>

<b><u>COATING</u></b>	<b><u>Limit VOC, Grams Per Litter (Less Water and Less Exempt Compounds)</u></b>
Flats	250
Floor Coatings	420
Graphic Arts (Sign) Coatings	500
High Temperature Industrial Coatings	420
Industrial Maintenance Coatings	420
Japans/Faux Finishing Coatings	350
Magnesite Cement Coatings	450
Mastic Coatings	300
Metallic Pigmented Coatings	500
Multi-Color Coatings	250
Non-Flat Coatings	250
Pigmented Lacquer	550
Pre-Treatment Wash Primers	780
Primers, Sealers, and Undercoaters	350
Quick-Dry Enamels	400
Quick-Dry Primers, Sealers, and Undercoaters	350
Recycled Coatings	250
Roof Coatings	250
Bituminous Roof Coatings	300
Rust Preventative Coatings	400
Shellacs:	
Clear	730
Pigmented	550
Specialty Primers	350
Stains	350
Swimming Pool Coatings:	
Repair	650
Other	340
Traffic Coatings	150
Waterproofing Sealers	400
Wood Preservatives	
Below-Ground	350
Other	350

**Table B1: ADHESIVES<sup>6</sup>**

<b><u>SUBSTRATE</u></b>	<b><u>Limit VOC, Grams Per Litter (Less Water and Less Exempt Compounds)</u></b>
Non-Vinyl Backed	150
Carpet Pad Installation	150
Wood Flooring Installation	150

<sup>6</sup> For more information, see SCAQMD Rule 1168: <http://www.aqmd.gov/rules/html/r1168.html>  
December 1, 2000

<b><u>SUBSTRATE</u></b>	<b><u>Limit VOC, Grams Per Litter</u> <u>(Less Water and Less Exempt Compounds)</u></b>
Ceramic Tile Installation	130
Dry Wall and Panel Installation	200
Subfloor Installation	200
Rubber Floor Installation	150
VCT and Asphalt Tile Installation	150
PVC Welding	510
CPVC Welding	490
ABS Welding	400
Plastic Cement Welding	850
Cove Base Installation	150
Adhesive Primer for Plastic	650
Multipurpose Construction	200
Structural Glazing	100
Single-Ply Roof Membrane	250
Adhesive Primer for Traffic Marking Tape	150

For adhesives, adhesive bonding primers, or any other primer applied to the following substrates, the following limits shall apply (Table B2):

**Table B2: ADHESIVES**<sup>7</sup>

<b><u>SUBSTRATE</u></b>	<b><u>Limit VOC, Grams Per Litter (Less Water and Less Exempt Compounds)</u></b>
Metal to Metal	30
Plastic Foams	120
Porous Material (except wood)	120
Wood	30
Fiberglass	200

\*If an adhesive is used to bond dissimilar substrates together the adhesive with the highest VOC content shall be allowed.

**Table C: SEALANTS**<sup>8</sup>

<b><u>SEALANTS</u></b>	<b><u>Limit VOC, Grams Per Litter (Less Water and Less Exempt Compounds)</u></b>
Architectural	250
Marine Deck	760
Nonmembrane Roof	300
Roadway	250
Single-Ply Roof Membrane	450
Other	420
<b><u>SEALANT PRIMERS:</u></b>	
Non Porous	250
Porous	775
Modified Bituminous	500
Marine Deck	760
Other	750

**Table D: VOC Limits – CARPET PRODUCTS**

DCAM has adopted The Carpet and Rug Institute's (CRI) quality assurance and indoor air quality standards for meeting its "Seal of Approval" emblem. CRI's test methodology for VOCs was developed by consensus during an official dialogue with the EPA and has been adopted by the American Society for Testing and Materials (ASTM) as D 5116 – Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products. All carpet products specified for installation should meet these standards, as outlined in the table below (note - these VOC levels are based on off-gassing emissions, not grams/liter content)<sup>9</sup>:

<b>CRI criteria are based on a maximum emission factor measured in mg/m<sup>2</sup> · hr as follows:</b>	
Total Volatile Organic Compounds	0.5
4-PC (4-Phenylcyclohexene)	0.05
Formaldehyde (to prove that none is used)	0.05
Styrene	0.4

### **Additional Chemical Compound Limits**

In addition to the VOC limits expressed in the above tables, DCAM has adopted limits regarding potentially hazardous chemical components as follows (these have been adopted by Greenseal and are referenced as minimum standards by the US Green Building Council):

<sup>7</sup> For more information, see SCAQMD Rule 1168: <http://www.aqmd.gov/rules/html/r1168.html>

<sup>8</sup> For more information, see SCAQMD Rule 1168: <http://www.aqmd.gov/rules/html/r1168.html>

<sup>9</sup> For more information, see the Carpet & Rug Institute at: [http://www.carpet-rug.com/drill\\_down.cfm?cftoken=51247669&cfdid=711300&page=5&requesttimeout=350](http://www.carpet-rug.com/drill_down.cfm?cftoken=51247669&cfdid=711300&page=5&requesttimeout=350)

1. None of these products can contain aromatic compounds composing more than 1.0% by weight of the sum total of the product.
2. Chemical Component Limitations - Other Chemicals: paint and coating products specified will not contain or utilize any of the following chemical compounds in the manufacture of the product.
  - Halomethanes: methylene chloride
  - Chlorinated ethanes: 1,1,1-trichloroethane
  - Aromatic solvents: benzene, toluene (methylbenzene), ethylbenzene
  - Chlorinated ethylenes: vinyl chloride
  - Polynuclear aromatics: naphthalene
  - Chlorobenzenes: 1,2-dichlorobenzene
  - Phthalate esters: di (2-ethylhexyl) phthalate, butyl benzyl phthalate, di-n-butyl phthalate, di-n-octyl phthalate, diethyl phthalate, dimethyl phthalate
  - Miscellaneous semi-volatile organics: isophorone
  - Metals and their compounds: antimony, cadmium, hexavalent chromium, lead, mercury
  - Preservatives (antifouling agents): formaldehyde
  - Ketones: methyl ethyl ketone, methyl isobutyl ketone
  - Miscellaneous volatile organics: acrolein, acrylonitrile

\*As with all products, designers shall ensure that at least three manufacturers can meet any specification.

## Section 5: Description of Life Cycle Cost Analysis (LCCA)

Life cycle cost analysis (LCCA) estimates the true cost of a building, or its components over its anticipated lifetime. LCCA includes not only the initial capital cost, but also operation and maintenance costs calculated in present value. The design team will be expected to undertake LCCA to justify design decisions.

MGL Ch. 149 Section 44m and MGL Ch. 164 Section 331 require the Division of Asset Management to consider the life-cycle cost (LCC) of implementing energy efficient and water conserving technologies, including the use of renewable fuels, in new construction or major renovation projects. This LCC analysis will evaluate building components that have a bearing on energy use and resource efficiency, including, but not limited to: building envelope, HVAC systems, heat recovery systems, motors and drives, variable air volume systems, cooling towers, lighting, controls, and some sustainable building materials.

The study team typically will identify appropriate measures that warrant LCCA. Absent this designation in the study, DCAM's Energy Team will identify the measures soon after the partnering/B-conference. DCAM expects that design teams are familiar with the basic economic analysis required to perform LCCA. The Energy Team will be available to guide and facilitate this process with the design team principals.

The list of measures for which LCCA will be performed may be revised by the design team in consultation with DCAM. LCCA will include the elements discussed below. Results of the LCCA will be discussed by the design team and DCAM in determining the final design.

### **Life Cycle Cost Analysis Requirements**

#### Systems/Equipment

Life cycle cost analysis (LCCA) is to be performed for a variety of major building systems to evaluate the life cycle costs of owning and operating systems of alternate specifications. For each measure, a minimum of three alternatives should be evaluated. Typically, these options will be for similar-performing items of different efficiencies or configurations such as various fuel types (e.g., gas chillers as well as electric) or technology types (e.g., evaporative vs. air-cooled condensers). Alternately, systems of considerably different design which are functionally similar may be evaluated and compared as design alternatives (e.g., ground source heat pumps vs. standard boilers and a/c or rooftop units).

#### Cost Factors

The analysis should include capital, maintenance and energy costs as well as any rebates that might be available from the electric and/or gas utilities for high efficiency equipment. Capital costs are to reflect the full installed price and available rebates. Maintenance costs are to be estimated on an annual basis and should be subject to an annual escalation rate (typically 3-4%). Energy costs ought to also reflect price escalation (typically 4%) to account for uncertainty in the energy markets and the potential for future increases in energy costs. Both estimated construction costs, and a net present value (NPV) of capital plus energy and O&M costs ought to be calculated for the expected life of the measure (typically 20 years for most building systems like lighting and HVAC). Annual discount rates of 4% and/or 7% should be applied to discount out-year future cash flows.

#### Other Considerations

Systems which present the least cost in net present value terms and demonstrate simple payback of 12 years or less are to be specified unless extraneous or additional considerations provide significant overriding concern (e.g., system won't fit in space provided; only one manufacturer provides product type specified (proprietary); system LCCAs are close in value (in NPV); or simple paybacks are inordinately lengthy).

### Data Needs and Related Considerations

LCCAs ought to include the following items:

- Description of options (including size & efficiency level of equipment)
- Hours of operation including annual seasonal variability
- Initial estimated construction cost (equipment, additional design, installation and associated costs)
- Utility rebates, where available
- Energy usage & costs expected per year or season for product/system based on operating hours and heating/cooling degree days particular to the job. LCCA will typically be calculated for a 20 year period for most major building systems, and should include energy price escalation rate of 4%/year)
- Maintenance costs on an annual basis (including any additional training, etc)



- Net cost per year in net present value (NPV) terms to show costs expected from procuring and operating system for the life of the equipment (typically calculated at 20 years)
- Other factors (positive and negative) to be considered (e.g., space considerations, etc.) which will affect the availability or applicability of alternate options or design schemes.

## Section 6: Other Sustainable Design Considerations

A large number of other sustainable design considerations ought to be weighed by design teams for inclusion in designs. A few of those which do not fit the categories discussed earlier in this document are discussed briefly below. This limited list is not a complete list of such design considerations, but it serves as a list of some of the suggested sustainable design considerations, which DCAM would like designers to examine.

Representatives of DCAM's Office of Construction Services will be available to design teams to help facilitate all sustainable design considerations. DCAM additionally reserves the right to provide sustainable design guidance to design teams for systems and features not discussed here.

### Bicycle commuter considerations:

Designers should consider developing amenities in buildings, which encourage bicycle commuting where possible. Such designs ought to include bicycle parking and locking facilities and appropriate shower and locker facilities for staff, students or other occupants who might utilize such means of travel to the building.

### Construction and Demolition Waste:

Designers should specify that contractors should seek to employ effective strategies for the separation and recycling of construction and demolition (C&D) wastes for all projects. Such strategies should include the separation and diversion to qualified recyclers and processors of any and all materials that can safely and effectively be reused or processed for recycling. There are a number of organizations that can provide additional support and guidance to that process; it is suggested that contractors contact these entities for technical assistance in dealing with C&D wastes. (E.g., Boston Building Materials Cooperative, Inc. & Building Materials Resource Center).

### Daylighting/Sun control:

Whenever possible, designers should seek to orient occupied building space toward natural light sources and incorporate daylighting into the building as the preferred mode of interior illumination. Natural daylighting, in conjunction with the lighting design will prove rewarding to the building's energy budget and to the productivity and wellbeing of building occupants. Overheating of internal spaces should be avoided by utilizing glass with sufficient shading coefficient as well as through proper thermal massing or shading.

### Design for recycling:

Designers ought to consider providing dedicated areas for recyclables collection, including bins, chutes and other accommodations to promote ease of waste management and recycling.

#### Energy modeling/System interactions

Designers should be encouraged to utilize whole building energy modeling and performance evaluation software to study, understand, and design for the interactions between various building systems. Such evaluations should consider the affects of lighting, office machines, sunlight & weather, building envelope & windows, as well as occupants' building use and occupancy patterns on the building as a whole and on the HVAC system in particular. Building management and controls systems should account for these effects and feedback in order to ensure proper building operations and management.

#### Environmentally preferable materials:

In addition to selection of architectural products and other materials, which demonstrate low levels of VOC content, or offgassing potential, designers should consider the maximum use of environmentally preferable products. Such products might include high levels of recycled-content materials, such as recycled plastic toilet partitions or outdoor benches, use of local or regional resources, specification of wood from sustainably harvested, certified sources, and the avoidance of products which use of ozone-depleting compounds such as in foam products or refrigerants.

#### Full building commissioning:

Designers should work with DCAM project management to consider the need for commissioning procedures and protocols in the design, construction, acceptance and occupancy phases of the project. DCAM project management should be consulted regarding commissioning plans, as certain facilities will have more significant commissioning requirements than others. Of course, it is expected that all buildings perform efficiently and according to design intent.

#### Site and design planning:

Designers should seek to analyze site resources and building orientation to both conserve and restore ecological resources and maximize ability of natural systems to aid in meeting building performance. Such goals could be accomplished through a number of design considerations, including utilization of natural light for lighting and heating, avoidance of too much glass on North facing aspects to avoid winter heat loss, and employing landscape considerations protective of the natural environment. Additionally, designers should seek to carefully redevelop brownfield sites and maximize preservation of open space whenever possible and practicable.

#### Water-using products and water conservation:

In addition to those items listed above in Section 1 (Division 15400, Plumbing), designers should employ seek to minimize the use of fresh water in the building as well as minimizing the discharge of water effluents in the waste stream. Strategies to achieve this goal might include the specification of automatic shut-offs or infrared sensors for bathroom fixtures, the use of native perennials in the landscape design as opposed to water-intensive lawns, the potential design of greywater systems or rainwater collection for site irrigation, or the potential design of garden roof systems which can drastically reduce stormwater runoff from buildings.

## Section 7: References, Information sources, etc.<sup>10</sup>

The following lists provide some helpful resources that might be utilized to gather more information on sustainable design related topics. By no means is this list meant to be exhaustive, authoritative or in any way connote DCAM approval or endorsement.

### **Building Commissioning**

U. S. General Services Administration Model Commissioning Plan and Guide Specification at: <http://www.peci.org/cx/mcpgs.html>

The Building Commissioning Association at: <http://www.bcx.org/>

ASHRAE Technical Committee (TC) 9.9 - Building Commissioning at: <http://www.ecw.org/tc99/>

### **Building Materials**

South Coast Air Quality Management District of California, Rules # 1113 (Architectural Coatings) & 1168 (Sealants and Adhesives) at: <http://www.aqmd.gov/rules/html/r1113.html> & <http://www.aqmd.gov/rules/html/r1168.html>

Certified Forest Products Council at: <http://www.certifiedwood.org/>

Commonwealth of Massachusetts' Operational Services Division's Environmentally Preferable Products (EPP) Procurement Program at: <http://www.magnet.state.ma.us/osd/enviro/enviro.htm>

### **Energy Efficiency**

ASHRAE/IES 90.1-1989 - Energy Efficient Design of New Buildings Except New Low-Rise Residential Buildings at: <http://www.ashrae.org/>

U.S. Department of Energy's Energy Efficiency and Renewable Energy Network (EREN) Building Topics at: <http://www.eren.doe.gov/EE/buildings.html>

California Energy Commission's Energy Efficiency Standards for Residential and Nonresidential Buildings, (Title 24, Part 6) at: <http://www.energy.ca.gov/title24/index.html>

U.S. Environmental Protection Agency Energy Star Buildings Program at: <http://www.epa.gov/buildings/> Additional info available by calling: 800-STAR-YES

Energy Efficient Building Association at: <http://www.eeba.org/>

### **Energy Modeling**

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<sup>10</sup> many references taken from the US Green Building Council at: <http://www.usgbc.org/resource/index.htm>

US Department of Energy's Office of Building Technology, State and Community Programs' Building Energy Software Tools at: [http://www.eren.doe.gov/buildings/tools\\_directory/](http://www.eren.doe.gov/buildings/tools_directory/) & [http://www.eren.doe.gov/buildings/tools\\_directory/database/page.cfm?Cat=EnergySim&Status=Yes&Menu=1&Sel=1&Desc=Energy+Simulation](http://www.eren.doe.gov/buildings/tools_directory/database/page.cfm?Cat=EnergySim&Status=Yes&Menu=1&Sel=1&Desc=Energy+Simulation)

US Department of Energy's Building Energy Modeling and Simulation - Self-Learning Modules at: [http://www.eren.doe.gov/buildings/tools\\_directory/software/bems-slm.htm](http://www.eren.doe.gov/buildings/tools_directory/software/bems-slm.htm)

## **Erosion Control**

US Environmental Protection Agency - Design of Stormwater, Sediment, and Erosion Control Systems at: <http://www.epa.gov/owow/watershed/wacademy/training/coll2.html>

## **General Sustainable Design & Green Building Principles/Programs/Information**

Architects, Designers, Planners for Social Responsibility at: <http://www.adpsr.org/NewPages/Directory.html>

Environmental Building News at: <http://www.buildinggreen.com/>

Environmental Design & Construction Magazine Online at: <http://www.edcmag.com/>

Green Builder Advisor software at: <http://www.greenbuildingadvisor.com/>

Rocky Mountain Institute's Green Development Service at: <http://www.rmi.org/sitepages/pid168.asp>

State of Pennsylvania's Green Building Initiative at: <http://www.gggc.state.pa.us/GreenBldg/greenhom.htm>

Sustainable Buildings Industry Council at: <http://www.sbicouncil.org/>

University of Virginia's Institute for Sustainable Design at: <http://www.virginia.edu/~sustain/>

US General Services Administration's real Property Sustainable Development Guide at: <http://policyworks.gov/org/main/mp/gsa/home.html>

US Department of Energy's Center of Excellence for Sustainable Development at: <http://www.sustainable.doe.gov/>

US Department of Energy's Office of Building Technology, State and Community Programs' Commercial High Performance Buildings project at: [http://www.eren.doe.gov/buildings/highperformance/chp/building\\_inventory.html](http://www.eren.doe.gov/buildings/highperformance/chp/building_inventory.html)

US Department of Energy (Pacific Northwest Laboratory) Office of Pollution Prevention - Pollution Prevention by Design homepage at: <http://www.pnl.gov/doesustainabledesign/>

## **Indoor Air Quality**

ASHRAE Standard 62-189 - Ventilation for Acceptable Indoor Air Quality (ANSI approved) at: <http://www.ashrae.org/>

Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Indoor Air Quality Guidelines for Occupied Buildings Under Construction at: <http://www.ashrae.org/> or contact SMACNA technical publications: 703-803-2980.

ASHRAE Standard 52.1-1992: Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI approved) at <http://www.ashrae.org/>

US EPA Indoor Environments Division Indoor Air Quality (IAQ) Home Page at: <http://www.epa.gov/iaq/>

## **Thermal Comfort**

ASHRAE Standard 55-1992: Thermal Environmental Conditions for Human Occupancy (ANSI approved) at: <http://www.ashrae.org/>

## **Water Conservation**

Energy Policy Act of 1992 – Plumbing Fixture Requirements (42 USC Section 6295(i) at: <http://www4.law.cornell.edu/uscode/42/6295.html>

U. S. Environmental Protection Agency Water Efficiency Program at: <http://www.epa.gov/owm/genwave.htm>

# APPENDIX M

## Sample Construction Sign

### SIGNAGE SPECIFICATIONS

To be included in Section 01500  
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

#### Project Identification

- A. The General Contractor shall furnish and install one 6' x 8' project sign, as indicated on the attached sketches, conforming to DCAM requirements. Such sign shall be fabricated from 1" thick MDO exterior plywood laminated with waterproof glue. All edges of sign shall be banded with 1" x ½" pressure-treated pine banding. (**NOTE:** SK-1(first sign) for single-lined project title; SK-2 (second sign) for double-lined project title)
- B. Sign shall be supported by 2 – 4" x 4" post supports set in 12" diameter concrete footings to a depth of four feet and so that sign is raised a minimum of 4' above grade. All nails, nuts, bolts and other connecting hardware shall be galvanized. (**NOTE:** Alternative methods of support may be required by site conditions)
- C. Sign shall be lettered by a professional sign painter, in accordance with the general layouts provided herein. Lettering to be gloss vinyl, size indicated on attached sketch (es). Letter styles shall be as indicated. Letter colors shall be as indicated.
- D. All surfaces of sign shall receive two coats of exterior primer followed by two coats of exterior gloss enamel.
- E. Submit shop drawing indicating sign construction and lettering.
- F. The DCAM Project Manager shall direct the location of the project sign.
- G. At completion of the project, remove the sign and supports completely.



# MASSACHUSETTS IS BUILDING

XXXXXX(project title by DCAM)XXXXXX

ARGEO PAUL CELLUCCI

Governor

JANE SWIFT

Lt. Governor

STEPHEN P. CROSBY

Secretary

COMMONWEALTH OF MASSACHUSETTS

DAVID B. PERINI

Committee Member

DIVISION OF CAPITAL ASSET MANAGEMENT

General Contractor

ABC Construction Co., Inc.

Architect-of-Record

XYZ & Associates, Inc.



# MASSACHUSETTS IS BUILDING

XXXXXX(project title by DCAM)XXXXXX  
XXXXXXXXXXXXXXXXXXXXXXXXXXXX

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Secretary

COMMONWEALTH OF MASSACHUSETTS

DAVID B. PERINI

Commissioner

DIVISION OF CAPITAL ASSET MANAGEMENT

General Contractor

ABC Construction Co., Inc.

Architect-of-Record

XYZ & Associates, Inc.



# APPENDIX R

## Guidelines for Designer's Work Plan

*[ Designer's Note: To assist both DCAM and the Designer in anticipating major milestones, permit requirements, review meetings and approvals, the Designer is required to submit a detailed work plan outlined as follows: ]*

### 1. Designer's work plan submission requirements:

- a) **Task Outline**: prepare a list of tasks that are anticipated for the duration of the design phase of the project. These may be either single sentences or brief descriptions of the activity required.
- b) **Drawing list**: prepare a list of all of the drawings anticipated for the project including existing conditions drawings, demolition drawings and all consultant drawings. This requirement is essential to confirm the scope of the project and to determine any additional services, which may be, required that are not included in the original scope.
- c) **List of Specification Sections**: prepare a list of all of the specification sections anticipated for the project.
- d) **Modified CPM or Annotated Bar Chart Schedule**: prepare a schedule that indicates the start and finish of all design activities and all dates of major milestones, permits, review meetings, quality control reviews and approvals. A modified CPM is not required, but a determination of priority events and a determination of the inter-relationship between events are an advantage to the project management.
- e) **Organization Chart**: prepare a chart indicating all of the key individuals involved in the project from the Designer, Consultants (all disciplines), DCAM and the User Agency. Indicate on the chart their telephone number, extension and E-mail address if available.
- f) **Contact List**: prepare a list of all of the key individuals involved in the project from the Designer, Consultants (all disciplines), DCAM and the User Agency. Include their title, address, telephone number and E-mail address if available.
- g) **Resumes of Key Individuals**: provide a resume of all of the individuals employed by the Designer and their consultants which are listed above.
- h) **Quality Control**: provide a description of the design phase quality control methods to be employed and when they will occur through out the design process.

### 2. Designer's work plan updates:

- a) The Designer shall update their work plan when changes in scope or additional clarity are required.

# APPENDIX S

## Instructions For Completing Standard Designer Evaluation Form – Study and Design

### Purpose

The purpose of this form is to fulfill the mandate of the law (Section 13 of chapter 159 of the Acts of 2000 which amends Section 38E of chapter 7) which requires State Agencies utilizing State funds to evaluate the performance of Designers.

### Responsibility

Responsibility for completing the evaluation forms rests with the Project Manager (PM) at the Public Agency. The evaluation is intended to be objective, independent and fair. The evaluation should be reviewed by the Project Manager's Supervisor and approved prior to its submission to the Designer. The Consultant Evaluation Form must be completed by the user Agency within 70 days of project final completion in order to be eligible for future State funds. Refer to the **Procedures** included in this package for full details.

### Process

Evaluation Forms are to be completed at a minimum at the completion of the project. If the role of the Designer is limited to design only, such as with a feasibility study or Master plan document, the Designer evaluation should be completed at the completion of the Study phase utilizing this Design Phase evaluation form. If the project involves both Design and Construction by the same designer, then both this Design Phase form and the Construction Phase form should be completed at the completion of the project. It is recommended that evaluations be submitted at both the completion of the programming phase of a Study and at the Study completion phase with the intention of providing the consultant with opportunities for corrective action to be taken prior to the completion of the project.

### Rating/Scoring

The rating for each category should be based on overall performance, but specific issues and problems can be noted through remarks annotated at the relevant category. The more detailed and constructive criticism, the more opportunity for the Consultant to respond and improve. Ratings should be entered in whole numbers (integers 1, 2, 3 or 4) only. The score should be calculated by multiplying each score by the weighting factor, (percentage noted inside box next to score) which is based on the relative importance of the various responsibilities. A score of 1 indicates dissatisfactory performance and must be accompanied by a detailed description of areas in need of improvement.

Indicate the project phase that has just been completed; note that Construction Administration utilizes a different form. All questions have relevance to each of the design phases of a project. Where a specific bulleted question does not apply, consider the overall numbered question.

- Question #1** This question addresses the Designer's ability to understand and interpret the design and program requirements of the project. It has the most relevance during the Study and early design phases, but should be evaluated even at CD's to be certain that the stated program/design requirements are carried throughout the entire development of the project.
- Question #2** The Designer has a responsibility to be mindful of the established budget limitations through all project phases. This question evaluates their attention to the budget including overseeing the work of the Cost Estimator and other consultants.
- Question #3** The Designer has a leadership role in the project to ensure overall communication and documentation as well as management and review of all sub-consultants' work. This section evaluates their ability to provide that leadership and review, as well as the quality of the documentation. If there was a problem with the performance of a subconsultant, it is ultimately the Designer's responsibility to resolve the issues – this is the section in which to document that situation. As a means to tracking dissatisfactory sub-contractor performance, be sure to indicate the name of any relevant subcontractor and describe the nature of the problems.
- Question #4** This question evaluates the Designer's technical expertise and their ability to communicate issues and facilitate resolution in a timely manner.
- Question #5** This question should document the ability of the Designer to maintain the schedule (where under their control) and provide appropriate and consistent staffing for the project. Was the Designer reasonable and responsible in their interpretation of the project scope, or did they consistently request additional services for work that was clearly within the contract scope?
- Question #6** Regulatory and permitting issues can have a major impact on project schedules, design and costs. Attention to these issues must be paid throughout the duration of the design process. This question documents the designer's leadership and technical capability in this area.
- Question #7** This question evaluates the quality of the Designer's communications from memos and meeting minutes to contract drawings and specifications. In phases where no contract documents are produced, evaluate the quality of the progress drawings, presentation materials or other communications and submissions. Did the Designer incorporate the comments and respond to the feedback received from all parties during the design process?

Project Manager's are encouraged to add remarks to elaborate on the ratings and to provide additional feedback to the consultants.

Study/Design Consultant: \_\_\_\_\_ Date Completed: \_\_\_\_\_  
 Project Title: \_\_\_\_\_ Project #: \_\_\_\_\_  
 Contracting Agency: \_\_\_\_\_ Project Manager: \_\_\_\_\_  
 Signature Public Agency Official or Owner's Representative: \_\_\_\_\_



Phase: \_\_\_\_\_

**1. Designer's responsiveness to Capital Asset Management and User Agency design and program criteria.**

- Did the Designer incorporate the articulated goals and criteria of the design program?
- Did the Designer analyze, interpret and discuss suggestions and issues in a professional manner?
- Did the Designer actively participate in meeting discussions?
- Did the Designer follow through on decisions made at meetings and respond to reviewer comments?
- Did the Designer work well with the Public Agency and other project participants?

_____	X.10=	_____
Rating		Score

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**2. Designer's adherence to established project budget limitations.**

- Was the Designer responsive to the established budget?
- Did the Designer work creatively to achieve the program goals within the existing budget?
- Did the Designer review and adjust the cost estimate to achieve the established project goals within budget limitations?

_____	X.10=	_____
Rating		Score

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**3. Designer's ability to effectively manage the project team and relay information to its consultants and personnel.**

- Did the Designer keep the team members informed of issues?
- Did the Designer effectively use the project team members as informational resources?
- Did the Designer adequately review subconsultants' work prior to submittals for review approval?
- Did the Designer take responsibility for ensuring the quality of work from all subconsultants and adequately coordinate the different trade's work in Design.

_____	X.05=	_____
Rating		Score

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**4. Designer's ability to solve technical/design problems.**

- Did the Designer address design constraints and take advantage of design opportunities?
- Did the Designer identify design problems in a timely manner?
- Did the Designer propose design alternatives and articulate their advantages/disadvantages?
- Was the Designer able to balance technical issues and aesthetics issues?

_____	X.15=	_____
Rating		Score

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**5. Designer's ability to submit complete design/study packages within the established project specific schedules and fee.**

- Did the Designer prepare submittals in accordance with the agreed upon schedule?
- Were the submittals complete?
- Did the Designer alert the Project Manager to possible schedule problems in advance of delays?
- Did the Designer staff the project appropriately and in keeping with their original application?
- Did the Designer make requests for additional services fees for work that was within the scope of the contract?

Did the

	X.25=	
Rating		Score

Did the

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**6. Designer's ability to manage its responsibilities in the regulatory/approvals process.**

- Did the Designer adequately research and document building code and life safety/accessibility issues?
- Did the Designer assist the Project Team in understanding codes/regulations and their implications?
- Did the Designer pay adequate attention to regulatory restrictions during the design process?
- Did the Designer make timely submittals of permit applications materials?

X.10=

	X.10=	
Rating		Score

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**7. Quality of the Study Report/Progress/Design/Contract Documents.**

- Were the materials submitted complete in all respects?
- Was the writing style/presentation clear and straightforward with adequate back up?
- Were all comments and review requests adequately incorporated into the report/documents?
- Were the contract documents sufficiently clear and complete that no addenda or only minor addenda had to be issued?
- Were the contract documents well coordinated?
- Was the Designer thorough and consistent in its use of graphic symbols and terminology?

X.25=

	X.25=	
Rating		Score

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Total Rating

--

Remarks: (include additional sheets as necessary)  
Score

Total

Overall Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## **Instructions for Completion of Designer Evaluation Form - Construction**

### **Purpose**

The purpose of this form is to fulfill the mandate of the law (Section 13 of chapter 159 of the Acts of 2000 which amends Section 38E of chapter 7) which requires State agencies utilizing State funds for building projects to evaluate the performance of Designers.

### **Responsibility**

The evaluation is intended to be objective, independent and fair. The evaluation should be completed by the Project Manager (PM) and reviewed by the Supervisor and approved prior to its submission to the Designer. The Consultant Evaluation Form must be completed by every Public Agency within 70 days of project final completion in order to be eligible for State funds. Refer to the **Procedures** included in this package for full details.

### **Process**

Evaluation Forms are to be completed at a minimum at the completion of the project. It is recommended that evaluations be completed at several stages of the Design and Construction Process with the intention of providing the consultant with opportunities for corrective action to be taken prior to the completion of the project. If the project involves both Design and Construction by the same designer, then both the Design Phase form and this Construction Phase form should be completed at the completion of the project.

### **Rating/Scoring**

The rating for each category should be based on overall performance, but specific issues and problems can be noted through remarks annotated at the relevant category. The more detailed and constructive criticism, the more opportunity for the Consultant to respond and improve. Ratings should be entered in whole numbers (integers 1, 2, 3 or 4) only. The score should be calculated by multiplying each score by the weighting factor, (percentage noted inside box next to score) which is based on the relative importance of the various responsibilities. A score of 1 indicates dissatisfactory performance and must be accompanied by a detailed description of areas in need of improvement.

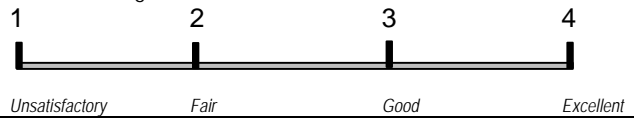
*Indicate the project phase that has just been completed; note that Design utilizes a different form. All questions have relevance to each of the construction phases of a project. Where a specific bulleted question does not apply, consider the overall numbered question.*

- Question #1** This question documents the Designer's ability to administer the construction contract through timely and thorough review of the Contractor's work. It also is a place to comment on their capability in terms of documentation of the review and adequate back up to support their approvals and disapprovals. The quality and thoroughness of punch lists and the Designer's ability to lead the project meetings at the site should be commented on here.
- Question #2** The Designer has the responsibility to provide oversight for all of the sub-consultants and to manage the Design Team through the execution of the construction. Evaluate the Designer's competence in team leadership and their attention to details of the sub-consultants work as well as their own. The role of coordination continues through construction and is particularly time sensitive at this stage. Was the Designer available and responsive to the need to bring the Design Team together to resolve construction issues? If there was a problem with the performance of a subconsultant, it is ultimately the Designer's responsibility to resolve the issues – this is the section in which to document that situation. As a means to tracking dissatisfactory sub-contractor performance, be sure to indicate the name of any relevant subcontractor and describe the nature of the problems.
- Question #3** Without regard to the reason for a change order (this is addressed in question #5) was the Designer thorough and prompt in providing requests for changes and documenting the reasons for the change? Did the Designer work to establish a cooperative relationship with the Contractor in order to facilitate negotiation and execution of needed changes?
- Question #4** When problems arose during construction, was the Designer prompt, responsive and creative in providing solutions? Did the Designer provide adequate attention to the problems in order to facilitate prompt resolution?
- Question #5** This question should address the quality of the Designer's construction documents as experienced through the progress of construction. Regardless of the GC or subcontractor's competencies, were the documents proven to be complete, easily read and utilized throughout the construction. This is an opportunity to document any areas where the PM feels that the Designer could have provided more detail or should have carried out more research during design. The quality of the documents should be reflected in the number of no-fee change orders - if change orders were high for some reason beyond the Designer's control, they should not be penalized. Errors and omissions requiring change orders or creating other problems should be documented here.
- Question #6** This question evaluates the Designer's ability to maintain adequate and thorough communications with the PM throughout the construction process. Were the communications clear and timely? Did the Designer have the technical capabilities to meet the requested/required electronic documentation and communication throughout the project?
- Question #7** The Resident Engineer (RE) or Clerk of the Works (CW) plays a very critical role in ensuring the construction is overseen and all issues are documented and promptly addressed. The ability of the RE/CW to fulfill this role is highly dependent on the support and commitment of the Designer to working with the RE/CW. This question should document that relationship and objectively evaluate the role of the Designer in supporting the RE in the field.

Project Manager's are encouraged to add remarks to elaborate on the ratings and to provide additional feedback to the consultants.

Design Consultant: \_\_\_\_\_ Date Completed: \_\_\_\_\_  
 Project Title: \_\_\_\_\_ Project #: \_\_\_\_\_  
 Contracting Agency: \_\_\_\_\_ Project Manager: \_\_\_\_\_  
 General Contractor \_\_\_\_\_

Performance Rating Scale:



Signature Public Agency Official or Owner's Representative: \_\_\_\_\_

### 1. Contract administration.

- Did the Designer provide adequate support during the Bid and Award process?
- Did the Designer attend and adequately lead all of the job meetings?
- Did the Designer completely review the requisitions (checking the math, %completion)?
- Did the Designer facilitate project closeout/develop adequate punchlists?
- Did the Designer review the shop drawings/submittals thoroughly and in a timely manner (within 7-14 days)?

	X.20=	
Rating		Score

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### 2. Management of Consultants - Coordination.

- Did the Designer request and coordinate site observations by the sub-consultants at the appropriate times?
- Did the Designer review and analyze the sub-consultant's shop drawings/submittals and oversee their timely review in an accurate manner?
- Did the Designer respond in a timely manner to requests for information from Contractor?

	X.10=	
Rating		Score

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### 3. Evaluation and negotiation of change orders.

- Did the Designer prepare proposal requests which clearly defined the scope changes?
- Did the Designer assess the reasonableness of cost and time of the contractor's proposals?
- Did the Designer provide a thorough analysis and explanation of the reason for the change order?

	X.10=	
Rating		Score

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

### 4. Problem Resolution.

- Did the Designer provide solutions that were creative and appropriate and in a timely manner?
- Did the Designer suggest solutions that were cost effective?

	X.05=	
Rating		Score

Comments: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

## 5. Quality of Contract Documents.

- Were the consultants' drawings coordinated with the Designer's?
- Were the code requirements met and well documented?
- Were there a limited number of change orders as a result of the construction documents?
- Was the information systematic, logical, easily read and interpreted by the G.C. and Res. Engineer?
- Were the contract documents complete and clear with a limited number of requests for clarifications?
- Did the Designer demonstrate knowledge of and compliance with Chapter 149 requirements?

	X.40=	
Rating		Score

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## 6. Communication Skills.

- Was the Designer's written communication effective and informative?
- Was the Designer's technical capability in terms of electronic technology and information management adequate for the needs of the project?
- Did the Designer keep User Agency informed of construction progress?
- Did the Designer effectively communicate (negotiate when necessary) with local officials and the contractor?

	X.10=	
Rating		Score

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## 7. Support of the Resident Engineer

- Did the Designer provide direction to the R.E and work cooperatively with them to oversee the construction?
- Did the Designer give the R.E adequate resources and information to perform their job (plans, specs, other relevant communications)?
- Did the Designer provide the R.E with technical resources as needed to perform their work?

	X.05=	
Rating		Score

Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Total Rating

--

Remarks: (include additional sheets as necessary)  
Score

Total

Overall Comments: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## Miscellaneous Revisions

1. Revise the following to read, Procedures, General, Design Requirements: b) “All projects involving buildings or structures to be renovated, constructed or demolished shall be designed in accordance with the latest edition of the Commonwealth of Massachusetts State Building Code, Energy Conservation Building Code, **and any Federal building regulations which apply, specifically the Americans with Disability Act (ADA).**” (for additional information: <http://www.usdoj.gov/crt/ada/adahom1.htm>)
2. Revise the following to read, C. Schematics-Phase 1, 2. Design Requirements: a),(7), “A three dimensional representation, axonometric or perspective drawing or three aerial photographic views of the Designer’s study model to convey general massing of the project. ***If a study model is chosen as the method of three dimensional representation, the Commonwealth shall retain ownership of the model for the duration of the project.***”
3. Add the following possible sub sub-bid sections denoted by triple asterix to the Specification Format Section, B. Typical Section Titles: ***“Plumbing Insulation, Temperature Controls, Sheet Metal Ductwork, Duct Insulation, Balancing, and Fluid Treatment and Chemical Cleaning.”***
4. Remove the existing specifications for Computers, Item E. under 1.19 FIELD OFFICES and replace with the attached sheet of requirements:
5. Revise the following to read: 3. Drawing Requirements, item f), **“The system of numbering and sequence of drawings for projects shall be submitted to DCAM for approval.”***[the CAD Layer Guidelines were incorrectly referenced]*
6. Add the following item: 7. Thermal and Moisture Protection, Requirements, d) Dampproofing, **“(4) Emulsion-Type Dampproofing Material (for use in exterior cavity walls and for below grade concrete foundation wall surfaces: Use emulsified asphaltic fibrated mastic type containing non-asbestos inorganic fibrous reinforcement materials, certified not to contain Polynuclear Aromatic Hydrocarbons, Xylene or Methylene Bis-Phenylisocyanate.”**
7. Revise the following to read: Specifications, 15. Mechanical (HVAC) Requirements, O, 2. “Cover all openings in equipment, pipes, and ducts with caps or heavy gauge plastic sheeting at the end of each work day **during storage and after installation**, until final connections are made.”



*[Note to Designer: These requirements will need to be updated on a regular basis, and adapted to the size of the project. In general these specifications will be appropriate for projects with a construction budget in excess of \$1 million]*

- a. Basic Workstation Unit (1 unit required)
  - (1) Minitower Personal Computer consisting of:
    - (a) Pentium Processor III, up to 1GHz, 512KB cache (minimum)
    - (b) 512 MB RDRAM
    - (c) 80 GB hard drive
    - (d) External CD – Rewritable SCSI Drive (8x write, 4x rewrite, 32x read)
    - (e) One (1) 3.5" high density floppy disk drive
    - (f) At least 3 ISA, 2 PCI open slots
    - (g) At least 2 open bays
    - (h) 10/100 Ethernet network interface card (Windows NT compatible)
    - (i) Internal Data/Fax Modem with 56.6 Kbps
    - (j) 2048 x 1536 at 75 Hz Video Card
  - (2) MONITOR:
    - (a) 17-inch or greater 1280 x 1024 SVGA color monitor which meets MPR II (low electromagnetic radiation) standard.
    - (b) .28mm pitch, non-interlaced
    - (c) Meets EPA Energy Star conservation standard (implemented in hardware)
  - (3) KEYBOARD
    - 101-key keyboard
- b. Laser Printer with 32 MB RAM, 8 pages per minute
- c. One (1) Ditto Max Professional Drive with 10 GB storage capacity
- d. Microsoft mouse & pad (1 required)
- e. System software (1 set required)
  - (1) Microsoft Windows (latest version)
  - (2) Expanded Memory Management
- f. Application Software (1 set required)
  - (1) Microsoft Office Professional for Windows (Latest version)
  - (2) Fax and data software for Windows.
  - (3) Service program from Internet access provider for the duration of the project.
  - (4) Primavera Project Planner P3 for Windows
  - (5) Primavera Expedition
  - (6) Training for three (3) persons, for all application software systems stated, by certified Primavera trainer.
  - (7) AutoCAD Architectural Desktop (latest version)
- g. Accessories: (1 set required)
  - (1) Dust covers for all equipment (CPU, video, keyboard, etc.)
  - (2) One (1) Surge protector
  - (3) Six (6) toner cartridges for the laser printer
  - (3) 50 Formatted Diskettes with sleeves and labels.
  - (4) Six (6) Ditto Max 10 GB Cartridges.
  - (5) 5,000 sheets 8 ½" x 11", 20 lb. white paper
  - (6) 200 CD-Recordables and 100 CD-ReWritables

F. Provide the Project Representative's office with the latest edition of the following documents:

*Instructions for Designers, Form 9, December 1, 2000*  
*Specifications*  
*II-F-26*

December 1, 2000

December 1, 2000